MONITORING PROGRAM ANNUAL REPORT
JANUARY - DECEMBER 2003

ANCHORAGE WATER AND WASTEWATER UTILITY
JOHN M. ASPLUND WATER POLLUTION CONTROL FACILITY
AT POINT WORONZOF

Prepared for:

MUNICIPALITY OF ANCHORAGE
Anchorage Water & Wastewater Utility
Anchorage, Alaska

Prepared by:

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February 2004

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PREFACE

This document is the Monitoring Program Annual Report required for submittal to the Environmental Protection Agency by NPDES Permit AK-002255-1 for discharge from the John M. Asplund Water Pollution Control Facility, operated by the Municipality of Anchorage at Point Woronzof. The NPDES permit incorporates provisions necessitated by a 301(h) waiver from the requirements of secondary treatment.

The elements of the monitoring program are:

- Influent, Effluent, and Sludge Monitoring
  - In-Plant Sampling
  - Toxic Pollutant and Pesticide Sampling
  - Pretreatment Monitoring
  - Whole Effluent Toxicity Monitoring
- Receiving Water Quality Monitoring
  - Plume Dispersion
  - Intertidal Zone Bacteria
- Sediment and Bioaccumulation Monitoring
  - Sediment Analyses
  - Bioaccumulation Analyses

During 2003, the program consisted of sampling the influent, effluent, and sludge twice for toxic pollutants and pesticides and one receiving water quality sampling. Sediment sampling was also performed during 2003. Bioaccumulation sampling was scheduled for 2003 but insufficient intertidal algae concentrations this year precluded the collection of samples. Bioaccumulation samples will be collected during 2004. In addition, the Municipality of Anchorage conducted the required self-monitoring program for the influent, effluent, and sludge.

This annual report provides information concerning the monitoring program performed to meet the requirements as set forth in the NPDES permit that became effective on 2 August 2000. The report covers the period of 1 January through 31 December 2003.

TABLE OF CONTENTS

TABLE OF CONTENTS, CONTINUED

LIST OF FIGURES

LIST OF TABLES

APPENDICES (BOUND SEPARATELY)

APPENDICES, CONTINUED (BOUND SEPARATELY)

SUMMARY

PURPOSE

This report is submitted in response to requirements of the U.S. Environmental Protection Agency (EPA) and the Alaska Department of Environmental Conservation (ADEC) as outlined in the National Pollutant Discharge Elimination System (NPDES) Permit AK-002255-1 that was signed on 30 June 2000 and became effective on 2 August 2000. This permit authorizes discharge of effluent from the John M. Asplund Water Pollution Control Facility (Asplund WPCF). Wastewater from the Municipality of Anchorage (MOA) is treated at this facility before discharge to the receiving waters of Knik Arm in Cook Inlet, Alaska. The NPDES permit incorporates the requirements necessitated by a 301(h) waiver from secondary treatment and is in compliance with provisions of the Federal Water Pollution Control Act as amended by the Clean Water Act (CWA, 33 U.S.C. §1251 et seq.) and the Water Quality Act of 1987, P.L. 100-4.

HISTORY

In September 1979, the MOA submitted to the EPA a 301(h) secondary treatment waiver application proposing an improved discharge which eliminated chlorination and required the addition of both a 610-meter (m) extension and a 305-m diffuser to the Asplund WPCF outfall. The outfall extension was intended to move the point of discharge beyond the influence of a gyre that was reported to exist off Point Woronzof on a flood tide which was presumed to carry effluent toward shore, causing bacterial contamination of the shoreline.

Further studies were subsequently undertaken to derive design criteria for the outfall improvements. The central issue was to evaluate outfall design alternatives and the chlorination/no chlorination option in relation to a system of eddies that occur on the flood tide. These studies were completed and presented as an Amendment to the Wastewater Facilities Plan for Anchorage, Alaska (CH2M Hill et al., 1985). This amended plan recommended the use of the existing 245-m outfall with the addition of a three-nozzle diffuser. It was shown that chlorination would be required to meet bacterial standards even with an extended outfall and diffuser. Because the same water quality standards could be met by chlorinating and installing an improved diffuser at the end of the existing outfall, there was no need to extend the outfall.

Concurrent with the studies to amend the facilities plan, a revised 301(h) waiver application was submitted to the EPA. After extensive EPA review, public comment, and hearings, the Final Permit Decision was issued and the five-year NPDES permit became effective 16 October 1985 (EPA, 1985a). As required by this permit, a multi-port diffuser was installed in August 1987 prior to the second year of receiving water sampling. Fourteen years of monitoring were performed under the initial NPDES permit.

The MOA submitted an application to renew the 301(h) waiver from secondary treatment in 1990. A more recent application was submitted in 1998 with additional information provided to EPA in 1999. A draft NPDES permit that incorporated the 301(h) waiver was issued in 1999 for public comment. The renewed permit was signed by EPA on 30 June 2000 to become effective on 2 August 2000. This five-year permit specifies the required monitoring program and expires on 2 August 2005.

RECEIVING WATER ENVIRONMENT

The Asplund WPCF discharges into Knik Arm, a unique body of estuarine water with extremely high tidal fluctuations (up to 11.6 meters [m] with a mean range of 7.89 m at Anchorage; NOAA/NOS, 1995). These fluctuations produce extensive tidal flats, swift tidal currents of 4 - 5 knots, and intense mixing within the Inlet. The water is almost a slurry because of the naturally high suspended sediment concentrations of up to 2500 milligrams/liter (mg/L). This sediment originates from glacial melt waters discharging into Cook Inlet.

Large temperature extremes occur between summer and winter. In the winter, ice can reach thicknesses of 1 - 2 m and consists of broken pieces due to the large tides and currents. Other important factors are the large volume of saline water present in Cook Inlet and mixing by tidal turbulence which allows this volume to be effective in wastewater dilution and assimilation.

MONITORING OBJECTIVES

The monitoring that was conducted during 2003 consisted of three main components: (1) in-plant monitoring of influent, effluent, and sludge, including whole effluent toxicity testing; (2) receiving water quality monitoring in the vicinity of the discharge and at a control site across Knik Arm; and (3) sediment monitoring in the vicinity of the discharge and at a control site across Knik Arm. Objectives of the 2003 program are summarized as follows:

2003 MONITORING OBJECTIVES

Influent, Effluent, and Sludge Monitoring

- determine compliance with the NPDES permit and State of Alaska water quality criteria
- determine effectiveness of the industrial pretreatment program
- aid in assessing the water quality at the discharge point
- characterize toxic substances
- help monitor plant performance
- determine compliance with the regulatory criteria of Section 301(h) of the CWA
- provide data for evaluation of permit re-issuance

Water Quality

- determine compliance with the NPDES permit and State of Alaska water quality criteria
- aid in assessing the water quality at the discharge point
- determine compliance with the regulatory criteria of Section 301(h) for the CWA
- determine the level of bacterial contamination in nearshore waters
- provide data for evaluation of permit re-issuance

Sediment Monitoring

- determine compliance with the NPDES permit and State of Alaska water quality criteria
- monitor for changes in sediment quality (organic enrichment, alteration of grain size distribution, and pollutant contamination)
- provide data for evaluation of permit re-issuance

MONITORING RESULTS

As part of its self-monitoring program, the Anchorage Water and Wastewater Utility (AWWU) conducted daily, weekly, and monthly sampling of influent, effluent, and sludge, depending on the parameter measured. In addition, monitoring for toxic pollutants and pesticides was conducted twice during 2003, once in June and August. Whole effluent toxicity testing was conducted quarterly, while water and sediment quality monitoring near the discharge were conducted once in June. The following summarizes results from this year's monitoring based on the permit requirements:

2003 MONITORING RESULTS

Influent, Effluent, and Sludge

- Met permit objectives and requirements and Alaska State water quality standards with the exception of fecal coliform. Results from parameters of particular concern are summarized below.

- MOA's self-monitoring of TRC showed that the daily maximum for TRC in the effluent was met for the entire year.

- The maximum geometric mean of 850 FC MPN/100 mL was exceeded in July 2003 for fecal coliform, when a mean of 1,141 FC MPN/100 mL was reported. Fecal coliform exceeded the monthly criteria "that not more than 10 % of the effluent samples shall exceed 2600 FC MPN/100 mL during any month" in June and July 2003, when 14 and 33 % of the samples exceeded this value, respectively. Exceedences resulted from the continuing adjustment of the Oxidation Reduction Potential chlorine feed control system in an effort to optimize chlorine use.

- Total aromatic hydrocarbon, total aqueous hydrocarbon, and total ammonia concentrations in effluent were below the maximum allowable effluent concentration (MAEC).

- Cyanide and metals concentrations in the effluent never exceeded their MAECs at any time during any of the 2003 sampling events.

- MOA's self-monitoring of pH, biochemical oxygen demand (BOD_5), and total suspended solids (TSS) showed compliance with permit effluent limitations. TSS and BOD_5 were well within the daily, weekly, and monthly criteria for the entire reporting period. The percent removal rate for both TSS and BOD_5 were well within required limits.

- Concentrations of toxic pollutants and pesticides, including metals and cyanide, in influent and effluent were generally within the established range or lower than values from a national study of secondary treatment plants.

- Most toxic pollutant sludge concentrations were within the established range or lower than values from a national study of secondary treatment plants. Most toxic pollutant sludge concentrations were within the established range or lower than values from a

national study of secondary treatment plants, with some metals falling outside typical concentrations but well below 95th percentile worst case values.

- Whole effluent toxicity testing conducted quarterly during 2003 met the permit limitations for chronic toxicity.

Water Quality

- Little variation among stations was observed for most hydrographic parameters.

- All intertidal fecal coliform samples met the most restrictive State water quality criterion of a median of 14 FC MPN/100 mL and the geometric mean not exceeding 20 FC MPN/100 mL was also met for both receiving water and intertidal samples. Fecal coliform concentrations in offshore receiving water samples from stations outside the ZID failed to meet the State-specified criteria of a median of 14 FC MPN/100 mL, a geometric mean of 20 FC MPN/100 mL, and of not more than 10 % of the samples exceeding 40 FC MPN/100 mL. Elevated offshore concentrations may be attributed to the effluent discharge, since concentrations at the outfall stations were significantly higher than those seen at the control. However, other stations more removed from the diffuser also showed high values, and other factors such as stream inputs may be influencing fecal coliform levels. All fecal coliform samples collected from intertidal areas met water quality criteria.

- Fecal coliform concentrations were statistically different within the zone of initial dilution (ZID), at the ZID boundary, and at the nearfield stations as compared to the control stations, with higher values seen at the outfall stations. High concentrations at some stations removed from the outfall were not necessarily attributable only to the Asplund WPCF discharge, as local creeks again exhibited relatively high fecal coliform concentrations.

- Supplemental receiving water quality samples obtained as part of the plume dispersion monitoring indicated that background levels of dissolved metals were all below the State site-specific water quality standards. Significant differences between the outfall and control stations were seen for dissolved arsenic, cadmium, copper, mercury, and zinc, which were elevated at the outfall. These increased concentrations as compared to controls may be attributed to the outfall, but all dissolved metals still met water quality standards. Total recoverable metals were elevated compared to the dissolved, as expected, and this was attributed to high suspended sediment loads. Only total recoverable arsenic was significantly elevated at the outfall stations as compared to the control, also possibly due to increased suspended sediment levels.

- Supplemental receiving water samples demonstrated that total aromatic hydrocarbons and total aqueous hydrocarbons exceeded the State's water quality standard at one outfall station, F1-2 at the ZID boundary. While no statistically significant differences were detected between concentrations at the control and outfall stations for total aromatic hydrocarbons, total aqueous hydrocarbons were significantly elevated at the outfall stations as compared to the control stations. These elevated levels could not be directly

attributed to the outfall, since concentrations measured in the effluent during the receiving water sampling were found to be low and only one outfall station showed elevated levels of these hydrocarbons.

- Turbidity, color, cyanide, and TRC met the State water quality criteria at all stations. Total residual chlorine levels were not found to be significantly different between outfall and control stations. All cyanide concentrations in receiving waters were below the detection limit of 1.0 µg/L except for the within-ZID Station F1-1, which exhibited a concentration of 2.0 µg/L.

- On September 4, 2003, grease and debris were inadvertently discharged to the outfall during the annual beach tower sluice gate maintenance. This caused a violation of the AWQS which states that discharges "Shall not cause a film, sheen, or discoloration on the surface or floor of the water body or adjoining shorelines. Surface waters shall be virtually free from floating oils." This incident was reported to EPA as required and the debris was immediately cleaned from the beach by AWWU.

Sediment

- Intertidal sediment analyses showed no evidence of outfall impacts. Data from outfall and control sites were similar in terms of chemical concentrations, with semi-volatile compounds, pesticides, dioxins, or asbestos found to be at or below detection limits. Cyanide was detected near the detection limit in one replicate from the control station. All metal concentrations were found to be substantially below NOAA's benchmark values indicative of probable environmental impact. Metals concentrations represent the natural metal levels that are associated with glacial silt in Cook Inlet. Subtidal substrates consisted of cobble and coarse gravel and were not subject to chemical analysis.

- Bioaccumulation sampling was not performed due to a lack of algae growth, most likely due to the dryness of the summer during 2003. This monitoring requirement will be performed in 2004.

CONCLUSIONS

Results from this year of the monitoring program confirm previous studies, data in the 301(h) waiver application, and the decision by the EPA to reissue the permit. The Asplund WPCF is operating within regulatory requirements with few exceptions and is showing no significant impacts to the marine environment.

1.0 INTRODUCTION

1.1 REGULATORY/ENVIRONMENTAL BACKGROUND

The monitoring program is designed to meet the requirements of the National Pollutant Discharge Elimination System (NPDES) Permit AK-002255-1 which authorizes discharge of municipal effluent into the Knik Arm of Cook Inlet receiving waters from the John M. Asplund Water Pollution Control Facility (Asplund WPCF), operated by the Municipality of Anchorage (MOA), Figure 1. The NPDES permit, which became effective on 2 August 2000, incorporates the requirements necessitated by a 301(h) secondary treatment waiver and is in compliance with provisions of the Federal Water Pollution Control Act as amended by the Clean Water Act (33 U.S.C. §1251 et seq.) and the Water Quality Act of 1987, P.L. 100-4.

1.1.1 Regulatory Background

In 1972, while the Asplund WPCF and outfall were being built for the MOA, the Federal Water Pollution Control Act (FWPCA) was amended to establish two phases of effluent limitations applicable to all Publicly Owned Treatment Works (POTWs). Under 301(b), POTWs were required to achieve secondary treatment of effluent by 1 July 1977 and the "best practicable waste treatment technology" by July 1983.

Congress again amended the FWPCA in 1977. Section 301(h) was added, providing that the Administrator of the EPA, upon application from a POTW and with the concurrence of the State, might issue an NPDES permit waiving the requirements of Section 301(b). On 15 June 1979, EPA promulgated the regulations regarding the issuance of this waiver of secondary treatment to an applicant discharging into certain ocean and estuarine waters and demonstrating compliance with the 301(h) criteria.

In September 1979, the MOA forwarded to the EPA a 301(h) waiver application proposing an improved discharge which eliminated chlorination and required the addition of both an extension and diffuser to the Asplund WPCF outfall. Earlier studies had recommended the construction of a 610-m outfall extension and a 305-m diffuser. The proposed extension/diffuser reportedly could meet fecal coliform receiving water standards without chlorination and prevent shore contact of the wastewater plume.

As a parallel program, the MOA undertook preparation of a wastewater master plan for the Anchorage Bowl area. The resultant Wastewater Facilities Plan for Anchorage, Alaska (Ott Water Engineers, Inc. et al., 1982) and the Environmental Impact Statement, City of Anchorage, Alaska, Wastewater Facilities (EPA and Jones & Stokes, 1982) were accepted by the EPA and the Alaska Department of Environmental Conservation (ADEC).

Further studies were subsequently undertaken to derive design criteria for the outfall improvements. Significant efforts were included in this study to improve the reconnaissance level data upon which the outfall length and diffuser design were to be based and to evaluate bacterial standards applicable to Knik Arm. The central issue was to evaluate outfall design alternatives and the chlorination or no-chlorination option in relation to the presence of a system of eddies that occur to the east of Point Woronzof on the flood tide and that might be capable of transporting the effluent shoreward.

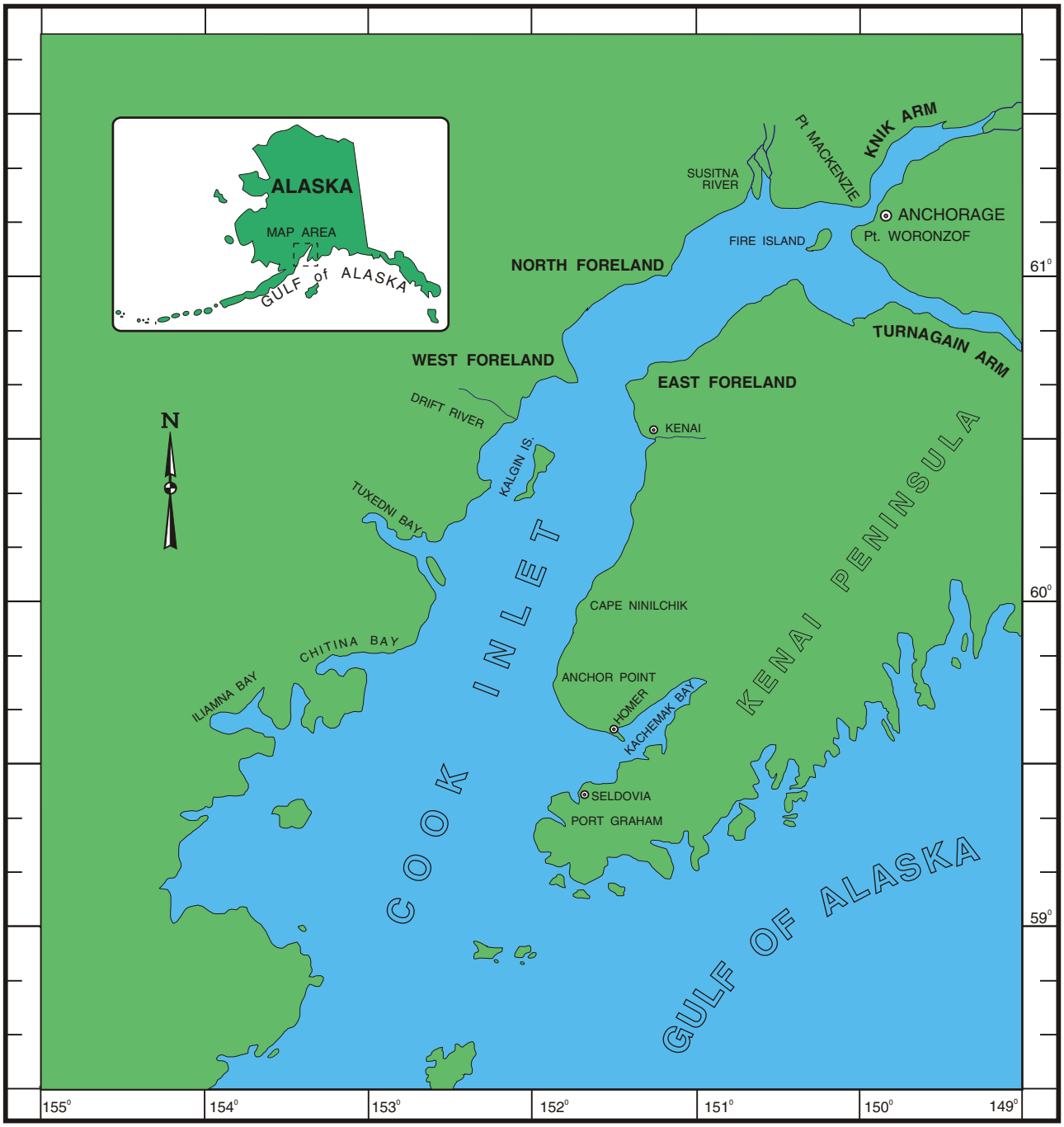


Figure 1. General Study Area.

These latter studies were completed and presented as an Amendment to the Wastewater Facilities Plan for Anchorage, Alaska (CH2M Hill et al., 1985). This amended plan recommended use of the existing 245-m outfall with the addition of a three-nozzle diffuser. It was shown that chlorination would be required to meet bacterial standards even with an extended outfall and diffuser. Because the same standards could be met by use of chlorination and the existing outfall, there was no need to extend the outfall. With continued chlorination, all water quality standards were predicted to be met by the amended plan.

Concurrent with the studies to amend the facilities plan, a revised application entitled Application for Modification of Secondary Treatment Requirements, Section 301(h), Clean Water Act was submitted to the EPA (CH2M Hill et al., 1984). The EPA Region 10 301(h) Review Team's Tentative Decision Document, entitled Analysis of the Section 301(h), Secondary Treatment Variance Application for the Asplund WPCF (EPA, 1985b), and a draft NPDES permit were made available for public comment on 17 January 1985. After comments and appropriate hearings, the Final Permit Decision (EPA, 1985a) was issued 13 September 1985, and the start date of the five-year NPDES Permit AK-002255-1 was listed as 16 October 1985. As required by this permit, a multi-port diffuser was installed at the Asplund WPCF outfall in the beginning of August 1987. This occurred prior to the 1987 summer water quality monitoring program. This original NPDES permit expired on 15 October 1990.

The MOA submitted a renewal application for the permit in April 1990 which addressed amendments made to the 301(h) provisions by the Water Quality Act. That renewal application was not acted upon and the facility continued to operate under an administrative extension of the 1985 permit until August 2000. In 1998 it was projected that the growth of Anchorage would result in the discharge limits contained in the 1985 permit being exceeded within a few years. Therefore, the MOA prepared and submitted another renewal application which replaced the 1990 application in October 1998 (CH2M Hill, 1998).

In tandem with the renewal application, the MOA conducted special studies and submitted a request for site-specific water quality criteria (SSWQC) to the ADEC for the Point Woronzof area of Cook Inlet in December 1998. This request for SSWQC was for turbidity and a suite of metals and was necessitated because the Alaska Water Quality Standards (AWQS) for marine waters could not be achieved for these waters as a result of the naturally high suspended sediment loads in Cook Inlet due to glacial inputs. The approach to the request was based on the EPA's recently promulgated Metals Policy which recommends the use of only the dissolved fraction of metals as bioavailable and appropriate for the protection of aquatic and associated beneficial uses of the water body. Following both agency and public review and comments, the SSWQC were incorporated into the AWQS as amended on 27 May 1999. The SSWQC for the Point Woronzof area included turbidity and the dissolved fraction of arsenic, cadmium, hexavalent chromium, copper, lead, mercury, nickel, selenium, silver, and zinc. At this time, EPA has not approved the SSWQC for acute nickel, acute and chronic selenium, and acute zinc since Alaska remains in the National Toxic Rule (NTR) for these pollutants. It is expected that Alaska will be removed from the NTR and the SSWQC approved by EPA for these metals in the near future (EPA, 2001; letter to ADEC).

Following the promulgation of these new AWQS, a tentative decision to grant the MOA its 301(h) variance was made by EPA on 4 November 1999. The tentative decision, draft NPDES permit, and fact sheet were then made available for public review and comments. The State of Alaska's Division of Government Coordination issued its Final Consistency Determination for

the action in February 2000. The new NPDES permit for the Asplund WPCF was signed by EPA on 30 June 2000, went into effect 2 August 2000, and expires on 2 August 2005.

The NPDES permit specified the required monitoring program. The Monitoring Program Plan (Kinnetic Laboratories, Inc., 2000a), submitted to the EPA in October 2000, identified how the MOA plans to fulfill the requirements of this program. This report documents the progress and results of the monitoring program performed in 2003 under the current NPDES permit.

1.1.2 Environmental Background

The Asplund WPCF discharges to the receiving waters of Cook Inlet, Alaska. The discharge is located off Point Woronzof in Knik Arm of Upper Cook Inlet.

Cook Inlet is a major tidal estuary that is approximately 333 kilometers (km; 180 nautical miles) long and 93 - 148 km (50 - 80 nautical miles) wide at its lower end. Bathymetry indicates the Inlet is deep, generally 36.6 m (20 fathoms) north of the Forelands and about 164.6 m (90 fathoms) at the mouth. Numerous rivers, including the major Susitna River drainage, discharge into the Inlet. A detailed map of the Point Woronzof region indicates deep water (9.1 - 51.8 m) extending well past Anchorage up the Knik Arm (Figure 2).

Cook Inlet is a unique estuary, with perhaps the closest parallel being the Bay of Fundy between New Brunswick and Nova Scotia, Canada. The occurrence of tidal bores at the head, currents of 4 - 5 knots, suspended loads of up to 2500 mg/L, large temperature extremes, and moving pancake ice of up to one meter (m) thick make Cook Inlet unique. The high tidal ranges result from the geometry of the Inlet which has a natural resonance period close to the semi-diurnal tidal period. The resulting large tidal currents cause complete vertical mixing of the Inlet waters.

In addition to these features, two other factors are important to this study. They are the very large volume of saline water present in the Inlet and the degree of mixing achieved by the tidal turbulence which allow these volumes to be effective in wastewater dilution and assimilation.

The particle size distribution of the natural suspended sediments off Point Woronzof show that very large particles are suspended by the current-generated turbulence, with 50 percent (%) of the load being in the size range of 65 - 250 microns. The settling of large particles is seen in the Inlet at slack tide. Settling rate tests of the suspended material show that 93 % of the solids in the ambient water sample settle in twenty minutes.

Previous work has indicated that due to the extremely swift currents, no seabed accumulation of suspended sediments, either natural or from the discharge, occur in the vicinity of the outfall. In this location, the bottom is strictly coarse gravel and cobble because of these currents. However, areas of deposition do exist, such as to the east of Point Woronzof, where mudflats and beaches are found, and to the southwest of the Point. The area between Fire Island and the mainland is hard-packed sand with no deposition of silt or finer materials as a result of the high current energy. Silt sedimentation is a difficult problem at the Port of Anchorage where the Corps of Engineers conduct annual dredging operations. Of course, any suspended solids in these materials of effluent origin would be diluted by the much larger natural load in the receiving water (400 - 2,500 mg/L versus approximately 50 mg/L effluent).

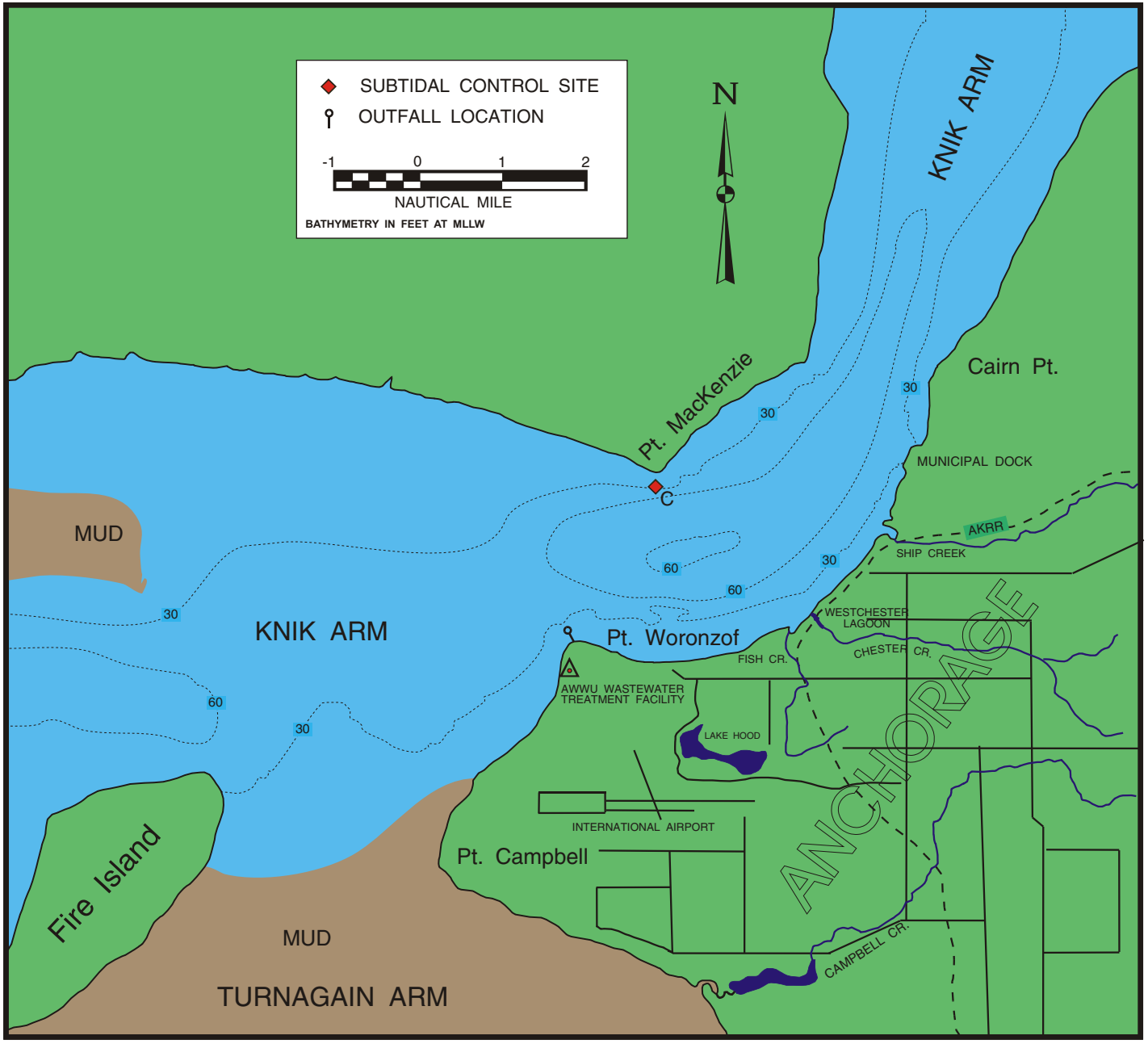


Figure 2. Asplund WPCF Outfall and Control Station Locations.

Studies have also shown that essentially no benthic biota are found on the scoured cobble/gravel bottom or on the rock beaches at Point Woronzof and the control area. Similar sampling of soft bottom beaches and tidal flats showed very sparse abundances and very low diversities. The harsh physical environment of silt, turbulence, currents, tides, and ice limit benthic and intertidal marine fauna populations.

Current trajectories in the immediate vicinity of the outfall are of concern because of flow separation zones on either side of Point Woronzof. Previous work has indicated that, on a flood tide, a clockwise system of eddies exist east of Point Woronzof. These eddies may result in the shoreward transport of wastes at certain stages of tide. A flow separation also exists to the west of Point Woronzof during ebb flow; however the effluent is not entrained shoreward in this area.

1.2 STUDY DESIGN

1.2.1 Monitoring Objectives

The monitoring program as described by NPDES Permit No. AK-002255-1 includes plant influent/effluent sampling; sewage sludge management procedures; water quality monitoring; biological and toxicological monitoring; and a toxics control program. The objectives of the overall monitoring program are to:

- determine compliance with the NPDES permit
- determine compliance with State of Alaska water quality criteria
- determine effectiveness of the industrial pretreatment program
- aid in assessing the water quality at the discharge point
- characterize toxic substances
- monitor plant performance
- determine compliance with the regulatory criteria of Section 301(h) of the Clean Water Act (CWA)
- determine the level of bacterial concentrations in nearshore waters
- monitor for changes in sediment quality (organic enrichment, alteration of grain size distribution, and pollutant contamination)
- determine if pollutants from the discharge are accumulating in exposed biological organisms
- provide data for evaluation of permit re-issuance

1.2.2 Program Description

The elements of the monitoring program for the Asplund WPCF are:

- Influent, Effluent, and Sludge Monitoring, including
  - In-Plant Sampling
  - Toxic Pollutants and Pesticides (including Metals and Cyanide)
  - Pretreatment Program
  - Whole Effluent Toxicity Testing (WET)

- Receiving Water Quality Monitoring, including
  - Plume Dispersion
  - Intertidal Bacteria

- Biological and Sediment Monitoring, including
  - Sediment Quality
  - Bioaccumulation

Table 1 provides an overview of the monitoring requirements as described by the permit. Detailed information regarding each program component is provided in Section 2.0, Methods.

1.2.3 Hypotheses

The null (no effect) hypotheses tested for this year of monitoring were as following:

H_o1: Applicable State and Federal effluent and receiving water standards were met by the Asplund WPCF discharge.

H_o2: Water quality at the boundary of the ZID was not significantly changed with respect to nearfield or control stations.

1.3 CONTRACTOR

The MOA's designated contractor for the 2003 Asplund WPCF Monitoring Program was Kinnetic Laboratories, Inc. (KLI) of Anchorage, Alaska.

For influent, effluent, and sludge monitoring, volatile and semi-volatile priority pollutant analyses (gas chromatography/mass spectrometry scans) were performed by ToxScan, Inc. in Watsonville, California, and Severn Trent Laboratories, Inc. of Sacramento, California. Trace metals (total and dissolved antimony, selenium, and thallium), aromatic hydrocarbon, pesticide, and WET testing were conducted by ToxScan, Inc. in Watsonville, California. Aromatic hydrocarbons were analyzed by McCampbell Analytical Laboratory, of Pacheco, California. Asbestos analyses were performed by Solar Environmental Services, Inc. of Anchorage, Alaska, and EMSL Analytical of Westmont, NJ.

In addition, the Municipality's Asplund WPCF Laboratory performed monthly in-plant analyses as part of its self-monitoring program and conducted trace metals and cyanide analyses for the toxic pollutant and pesticide, pretreatment, and Part 503 sludge monitoring.

Northern Testing Laboratories, Inc. (NTL) of Anchorage, under subcontract to KLI, also provided analytical and field support for the receiving water quality sampling for bacteriology, color, and total residual chlorine (TRC). Analytical support for the receiving water sampling was provided by Battelle Northwest for trace metals (Sequim, Washington), and by ToxScan, Inc. for aromatic hydrocarbons, total suspended solids (TSS), and cyanide. Polycyclic aromatic hydrocarbons (PAHs) and aliphatic hydrocarbon (AHC) analyses were provided by Texas A&M University's Geochemical and Environmental Research Group (GERG) in College Station, Texas.

1.4 PERIOD OF REPORT

This report documents the progress and results of the monitoring program from 1 January through 31 December 2003 under the current NPDES permit.

Table 1. Overall Monitoring Requirements.

Parameter	Frequency	Sample Type	Remarks
In-Plant Sampling	See Table 2	See Table 2	See Table 2 - includes flow, TRC, DO, BOD_5, TSS, temperature, pH, fecal coliform, total ammonia as nitrogen, enterococci bacteria, and oil and grease
Toxic Pollutants and Pesticides (including Metals and Cyanide)	2/year[a]	influent, 24-hr composite effluent, 24-hr composite sludge, 24-hr composite	See Table 2
Pretreatment Program	2/year[a,b]	influent, three 24-hr composite effluent, three 24-hr composite sludge, 24-hr composite (8 grabs/day)	Includes metals and cyanide plus percent solids for sludge
Whole Effluent Toxicity (WET) Testing	4/year[c]	effluent, 24-hr composite	See Table 2
Receiving Water Quality	1/year[d]	receiving water	See Table 5
Intertidal Bacteria	1/year[e]	intertidal receiving water	Fecal coliform sampling at 8 intertidal stations
Sediment	Once during the fourth year of the permit[e]	grab samples of surficial (0-2 cm) sediment collected at intertidal and subtidal stations[f]	Includes total volatile solids (TVS), toxic pollutants and pesticides (including metals and cyanide), and sediment grain size distribution
Bioaccumulation	Once during the fourth year of the permit[e,g]	grab samples of intertidal macroalgae (*Vaucheria* spp.)[h]	Includes toxic pollutants and pesticides (including metals and cyanide)

[a] Twice per year sampling will be conducted twice, once in dry conditions in summer and once in wet conditions.

[b] The first day of three consecutive days of sampling will be part of the Toxic Pollutant and Pesticides (metals and cyanide) sampling performed twice each year.

[c] WET testing will be performed on a quarterly basis.

[d] Sampling will be conducted once per year in summer dry conditions.

[e] Sampling will be conducted in conjunction with the receiving water sampling.

[f] Sampling will be performed at Intertidal Stations 1, 2, and Control (IT-1, IT-2, and IT-C); a subtidal station located at the ZID boundary, and a subtidal control station near Point MacKenzie (in a similar water depth as the ZID boundary).

[g] Sampling will be performed in conjunction with the sediment analyses.

[h] Samples will be collected at Intertidal Stations 1 (IT-1) and Control (IT-C). Ten replicate samples will be collected within a 10-m radius of the station.

2.0 METHODS

2.1 INFLUENT, EFFLUENT, AND SLUDGE MONITORING

Influent, effluent, and sludge monitoring is outlined in Table 2. Routine daily, weekly, and monthly sampling of conventional pollutant parameters and flow rate were performed by AWWU. The less-frequently monitored parameters of enterococci bacteria, oil and grease, toxic pollutants and pesticides (including metals and cyanide), and Whole Effluent Toxicity (WET) testing were handled by KLI.

- ✓ determine compliance with the NPDES permit and State of Alaska water quality criteria
- ✓ determine effectiveness of the industrial pretreatment program
- ✓ aid in assessing the water quality at the discharge point
- ✓ characterize toxic substances
- ✓ help monitor plant performance
- ✓ determine compliance with the regulatory criteria of Section 301(h) of the CWA
- ✓ provide data for evaluating re-issuance of this permit

2.1.1 In-Plant Monitoring

In-plant influent, effluent, and sludge sampling was performed by AWWU personnel as described in Table 2 and in a separate study plan provided by AWWU (AWWU, 2000). Samples were obtained following the schedule of frequency required by the permit. Influent was sampled at a representative location in the influent headworks, upstream from the recycle streams. Effluent was sampled at a well-mixed point downstream from the chlorination input (the final effluent line). Composite sludge samples were obtained from the belt filter press. Grab samples were obtained for TRC, dissolved oxygen (DO), temperature, pH, and fecal coliform. Composite samples were obtained for analysis of biochemical oxygen demand (BOD_5), TSS, and total ammonia as nitrogen.

2.1.2 Toxic Pollutant and Pesticide Monitoring

As outlined in the permit, toxic pollutant and pesticide sampling was conducted twice this year, once during June 2003 (summer dry) and once during August 2003 (summer wet). Samples were collected as required by the permit and either analyzed by AWWU personnel or provided to KLI for shipment to the appropriate analytical laboratory. Plant influent was sampled as discrete grabs or by flow-proportional composite samplers (depending on the analysis method) at a representative location in the influent headworks upstream from the recycle streams. Effluent was sampled as discrete grabs or flow-proportional samplers at a well-mixed point downstream from the chlorination input point in the final effluent line. Influent and effluent samples were chilled as required during composite sampling. Composite sludge samples were obtained from the belt filter press.

Samples were composited for the analysis of pesticides, semi-volatile organics, metals, asbestos, and cyanide. Samples consisted of composites of flow-proportioned samples collected over a 24-hr period using two ISCO Model 3700 Refrigerated Autosamplers. Grab samples for volatile organics analysis were collected every three hours during the 24-hr sampling period and designated for compositing during analysis at the laboratory. Grab samples were collected for

Table 2. Influent, Effluent, and Sludge Monitoring Requirements.

Parameter	Sample Point[a]	Sample Frequency	Sample Type
Flow[b]	effluent	continuous	continuous
Total Residual Chlorine (TRC)[b]	effluent	continuous or every 2-4 hrs	grab
Dissolved Oxygen (DO)[b]	effluent	4/week	grab
Biochemical Oxygen Demand (BOD_5)[b]	influent and effluent	4/week	24-hr composite
Total Suspended Solids (TSS)[b]	influent and effluent	4/week	24-hr composite
Temperature[b]	influent and effluent	4/week	grab
pH[b]	influent and effluent	4/week	grab
Fecal Coliform Bacteria[b]	effluent	3/week	grab
Total Ammonia as N[b]	effluent	1/month	24-hr composite
Enterococci Bacteria[c]	effluent	2/year[d]	grab
Oil and Grease[b]	effluent	2/year[d]	grab
Toxic Pollutants and Pesticides (including Metals and Cyanide)[e]	influent, effluent, and sludge	2/year[d]	24-hr composite
WET[f]	effluent	4/year[f]	24-hr composite

[a] When both influent and effluent samples are required, samples will be collected during the same 24-hr period.

[b] AWWU will perform this monitoring component.

[c] KLI will perform this monitoring component.

[d] Twice per year sampling: once during summer in dry conditions and once in wet conditions.

[e] As part of the pretreatment program sampling requirements, arsenic, cadmium, chromium, copper, cyanide, lead, mercury, nickel, silver, and zinc in influent, effluent, and sludge will be sampled, along with percent solids (in sludge only). These metals will be analyzed and reported by AWWU as total recoverable metals and dissolved metals for influent and effluent and as total metals in mg/kg dry weight for sludge. Sampling will be as follows: Influent and effluent as three separate 24-hr composite samples taken on 3 consecutive days (Mon - Fri), the first day of which coincides with the twice yearly sampling (summer-dry and wet conditions); sludge as one composite of eight grabs/day when influent and effluent samples are being taken. In addition, the other four metals from the toxic pollutant list will be analyzed in the summer wet/summer dry samples: beryllium (by AWWU) and antimony, thallium, and selenium (by KLI).

[f] WET requirements are summarized in the text. Initial testing will be a screening period performed during three quarters, during which three species will be tested to determine the most sensitive species. Re-screening will be performed each year during one quarter (different than the previous year) to determine the species to use for continued testing. Accelerated testing requirements will be triggered if chronic toxicity is greater than 143 TUc (chronic toxicity units, TUc=100/NOEC).

analysis of total hydrocarbons as oil and grease and purgeable aromatic compounds. Sludge samples were collected from the conveyor belt every three hours over a 24-hr period and the eight samples composited.

At time of collection, all samples were appropriately labeled using pre-prepared, project-specific sample labels as described in Section 2.4. Sample collection and shipment was documented using project-specific chain of custody forms as described in Section 2.4.

Toxic pollutants as defined by the permit are those substances listed in 40 CFR 401.15 (Table 3). This list involves 65 categories of pollutants, including asbestos, aromatic hydrocarbons, pesticides, metals, and polychlorinated biphenyls (PCBs). Pesticides as defined in the permit are demeton, guthion, malathion, mirex, methoxychlor, and parathion as listed in 40 CFR 125.58. Other pesticides which were tested are included on the toxic pollutants list (40 CFR 401.15). The methods that were used to analyze these constituents for this program and for which KLI will be responsible, as well as those performed by AWWU, are also provided in Table 3. Preservation and maximum holding time information for each of these methods is provided in Table 4. All samples were collected in the appropriate precleaned sample containers and preserved, if necessary, as described by the EPA method. All sample containers were immediately placed on gel ice after sampling. Samples remained chilled as required during shipment to the analytical laboratory.

2.1.3 Pretreatment Monitoring

The pretreatment program as outlined in Table 1 and Table 2 was performed by the AWWU. This monitoring was performed twice in 2003 in conjunction with the summer dry and wet sampling. As part of the pretreatment program sampling requirements, arsenic, cadmium, chromium, copper, cyanide, lead, mercury, nickel, silver, and zinc in influent, effluent, and sludge were sampled, along with percent solids (in sludge only). These metals were analyzed and reported by AWWU as total recoverable metals and dissolved metals for influent and effluent and as total recoverable metals in dry weight for sludge. Sampling was conducted as follows: Influent and effluent as three separate 24-hr composite samples taken on 3 consecutive days (Monday - Friday), the first or second day of which coincided with the twice-yearly sampling (dry wet and summer dry, respectively); sludge as one composite of eight grabs/day when influent and effluent samples were being taken. A study plan describing this has been provided elsewhere (AWWU, 2000).

2.1.4 Whole Effluent Toxicity Testing

As outlined in the permit, the WET testing must be performed on a quarterly basis on 24-hour composite effluent samples. Effluent was sampled by discrete flow-proportional samplers at a well-mixed point downstream from the chlorination input point in the final effluent line. Effluent samples were collected in the appropriate precleaned sample containers as described by the method, chilled, and shipped immediately to the toxicity laboratory for testing. Samples were appropriately labeled at the time of collection using pre-prepared, project-specific sample labels as described in Section 2.4. Sample collection and shipment were documented using project-specific chain of custody forms as described in Section 2.4. Sample containers were immediately placed on gel ice after sampling and remained chilled during shipment to the analytical laboratory.

Table 3. Methods[a] for the Analysis of Toxic Pollutants and Pesticides for Influent, Effluent, and Sludge Monitoring.

Volatile Organic Compounds	Semi-Volatile Organic Compounds	Pesticides and PCBs	Inorganic Compounds
SW 8021B/602 list (Inf/Eff) **SW 8260B (Sludge)** Benzene Chlorinated benzenes Dichlorobenzenes Ethylbenzene Toluene Xylenes[b]	**EPA 625 (Inf/Eff)** **SW 8270C (Sludge)** Acenaphthene Benzidine[c] Chloralkyl ethers Chlorinated ethanes Chlorinated naphthalenes Chlorinated phenols 2-chlorophenol DDT & metabolites Dichlorobenzenes Dichlorobenzidine 2,4-dichlorophenol 2,4-dimethylphenol Dinitrotoluene Diphenylhydrazine Fluoranthene Haloethers Heptachlor & metabolites Hexachlorobutadiene Hexachlorocyclopentadiene[c] Hexachloroethane Isophorone Naphthalene Nitrobenzene Nitrophenols Nitrosamines Polycyclic aromatic hydrocarbons (PAHs) Pentachlorophenol Phenol Phthalate esters	**EPA 614 (Inf/Eff)** **SW 8141A (Sludge)** Demeton Malathion Parathion Guthion[b]	**EPA 100.1/EPA 100.2 (Inf/Eff)** Polarized Light Microsopy (PLM; Sludge) Asbestos
EPA 624 (Inf/Eff) **SW 8260B (Sludge)** Acrolein[b] Acrylonitrile[b] Benzene Carbon tetrachloride Chloralkyl ethers Chloroform Chlorinated benzenes Chlorinated ethanes 1,2-dichloroethane Dichloroethylenes Dichloropropane Dichloropropene 1,1,1-trichloroethane Ethylbenzene Halomethanes Methylene chloride Bromoform Dichlorobromomethane Toluene Tetrachloroethylene Trichloroethylene Vinyl chloride	**SW 8280A (Inf/Eff/Sludge)** 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)	**EPA 608 (Inf/Eff)** **SW 8081A Pesticides and SW 8082 PCBs (Sludge)** Aldrin/Diedrin Chlordane (technical mixture& metabolites) DDT & metabolites Endosulfan & metabolites Endrin & metabolites Heptachlor metabolites Hexachlorocyclohexane Polychlorinated biphenyls (PCBs) Toxaphene Mirex[b] Methoxychlor[b]	**EPA 200.8 (Inf/Eff)** **SW 6020/SW 3050B (Sludge)** Antimony Thallium **EPA 270.3 (Inf/Eff)** **SW 7741A/SW 3050B (Sludge)** Selenium Note: other inorganic compounds will be analyzed by AWWU (Arsenic, Beryllium, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Silver, Zinc, and Cyanide)

Inf Influent
Eff Effluent

[a] "EPA" refers to the EPA document *Methods for Chemical Analysis of Water and Wastes*, revised March 1983, Document No. EPA-600/4-79-020 or 40 CFR 136; "SM" refers to *Standard Methods for the Examination of Water and Wastewater*, 18th ed., 1992. "SW" refers to the EPA Manual SW 846, *Test Methods for Evaluating Solid Waste.* 3rd Ed., 1986.

[b] Included with expanded method analyte list.

[c] Not the preferred method for this analyte.

Table 4. Preservation and Analytical Procedures for Influent, Effluent, and Sludge.

Parameter	Sample Type	Preservation	Maximum Holding Time	Method[a]
Temperature	Inf/Eff	None required	Analyze immediately	SM 2550B
pH	Inf/Eff	None required	Analyze immediately	SM 4500-H^+ B
BOD_5	Inf/Eff	Cool, 4°C	48 hours	SM 5210B
Total Residual Chlorine	Eff	Fill completely	Analyze immediately	Hach 8167
DO Electrode	Eff	None required	Analyze immediately	SM 4500-O G
Suspended solids	Inf/Eff	Cool, 4°C	7 days	SM 2540D
Total solids	Sludge	Cool, 4°C	7 days	SM 2540G
Enterococci	Inf/Eff	Cool, 4°C, $Na_2S_2O_3$ in effluent	24 hours	SM 9230B
Asbestos	Inf/Eff	Cool, 5°C, dark	Filter within 48 hours of receipt at lab	EPA 100.1/100.2
	Sludge	Cool, 5°C	28 days	Polarized Light Microscopy (PLM)
Fecal Coliform Bacteria	Eff	Cool, 4°C 0.008% $Na_2S_2O_3$	6 hours	EPA 600/8-78-017
Total Ammonia as N	Eff	Cool, 4°C, H_2SO_4 to pH <2	28 days	Hach 8038
Total Hydrocarbons as Oil and Grease	Inf/Eff	Cool, 4°C, dark HCl to pH<2	28 days	EPA 1664 HEM[b]
Volatile Organics	Inf/Eff	Cool, 4°C, dark, HCL to pH<2 $Na_2S_2O_3$ in effluent	14 days	EPA 624, EPA 602 and xylenes
	Sludge	Cool, 4°C	14 days	SW 8260B
Dioxins	Inf/Eff	Cool, 4°C	30 days until extraction/45 days after extraction	SW 8280A
	Sludge	Cool, 4°C	30 days until extraction/45 days after extraction	SW 8280A
Semi-Volatile Organics	Inf/Eff	Cool, 4°C, dark $Na_2S_2O_3$ in effluent	7 days until extraction/40 days after extraction	EPA 625
	Sludge	Cool, 4°C	14 days until extraction/40 days after extraction	SW 8270C
Pesticides & PCBs	Inf/Eff	Cool, 4°C, $Na_2S_2O_3$ in effluent	7 days until extraction/ 40 days after extraction	EPA 614 and EPA 608
	Sludge	Cool, 4°C	14 days until extraction/40 days after extraction	SW 8141A/8081A SW 8082

Table 4. Preservation and Analytical Procedures for Influent, Effluent, and Sludge. (continued)

Parameter	Sample Type	Preservation	Maximum Holding Time	Method[a]
Cyanide (total)	Inf/Eff	Cool, 4°C, NaOH to pH>12, 0.6 g ascorbic acid (in effluent)	14 days	SM 4500 CN C,E
	Sludge	Cool, 4°C	14 days	SM 4500 CN C,E
Arsenic	Inf/Eff	Cool, 4°C, HNO_3 to pH<2	6 months	EPA 206.2
	Sludge	Cool, 4°C	6 months	SW 7060/3050A
Beryllium	Inf/Eff	Cool, 4°C, HNO_3 to pH<2	6 months	EPA 210.2
	Sludge	Cool, 4°C	6 months	SW 7091/3050A
Cadmium	Inf/Eff	Cool, 4°C, HNO_3 to pH<2	6 months	EPA 213.2
	Sludge	Cool, 4°C	6 months	SW 7130/3050A
Chromium	Inf/Eff	Cool, 4°C, HNO_3 to pH<2	6 months	EPA 218.2
	Sludge	Cool, 4°C	6 months	SW 7191/3050A
Copper	Inf/Eff	Cool, 4°C, HNO_3 to pH<2	6 months	SM 3111B
	Sludge	Cool, 4°C	6 months	SW 7210/3050A
Lead	Inf/Eff	Cool, 4°C, HNO_3 to pH<2	6 months	EPA 239.2
	Sludge	Cool, 4°C	6 months	SW 7421/3050A
Mercury	Inf/Eff	Cool, 4°C, HNO_3 to pH<2	28 days	EPA 245.1
	Sludge	Cool, 4°C	28 days	SW 7470
Nickel	Inf/Eff	Cool, 4°C, HNO_3 to pH<2	6 months	EPA 249.2
	Sludge	Cool, 4°C	6 months	SW 7521/3050A
Selenium	Inf/Eff	Cool, 4°C, HNO_3 to pH<2	6 months	EPA 270.3
	Sludge	Cool, 4°C	6 months	SW 7741A/3050B
Silver	Inf/Eff	Cool, 4°C, HNO_3 to pH<2	6 months	EPA 272.2
	Sludge	Cool, 4°C	6 months	SW 7761/3050A
Zinc	Inf/Eff	Cool, 4°C, HNO_3 to pH<2	6 months	SM 3111B
	Sludge	Cool, 4°C	6 months	SW 7950/3050A
Antimony	Inf/Eff	Cool, 4°C, HNO_3 to pH<2	6 months	EPA 200.8
	Sludge	Cool, 4°C	6 months	SW 6020/3050B
Thallium	Inf/Eff	Cool, 4°C, HNO_3 to pH <2	6 months	EPA 200.8
	Sludge	Cool, 4°C	6 months	SW 6020/3050B (digestion)

a Unless otherwise noted, "EPA" refers to the EPA document *Methods for Chemical Analysis of Water and Wastes*, revised March 1983, Document No. EPA-600/4-79-020; "SM" refers to *Standard Methods for the Examination of Water and Wastewater*, 18th ed., 1992. "SW" refers to the EPA Manual SW 846, *Test Methods for Evaluating Solid Waste.* 3rd Ed., 1986.

b EPA, 1995. Document No. EPA-821-B-94-004.

Inf Influent samples
Eff Effluent samples
Sludge Sludge samples

Initial WET testing was performed as a screening period over the course of three quarters during each of which three toxicity tests were performed, each with one vertebrate and two invertebrate species. These screening tests were performed during the third and fourth quarters of 2000 and the first quarter of 2001. Screening included the vertebrate *Atherinops affinis* (topsmelt) for survival and growth; an invertebrate bivalve species (either *Mytilus* spp. [mussel; survival and growth] or *Crassostrea gigas* [oyster; larval development); and an invertebrate echinoderm species fertilization test (*Strongylocentrotus purpuratus* [purple urchin] or *Dendraster excentricus* [sand dollar]). Once the screening period was completed, the single most sensitive species (bivalve) was used for subsequent toxicity testing until re-screening was completed. As required by the permit, re-screening must be performed each year during one quarter (different than the previous year) to determine the most sensitive species to use for continued testing. Re-screening was performed in the second quarter of 2002, with bivalve testing performed during the other three quarters. In 2003, re-screening was performed during the third quarter, and bivalve testing was performed during the remainder of the year.

Accelerated testing requirements will be triggered if chronic toxicity is greater than 143 TUc (chronic toxicity units, TUc=100/No Observed Effect Concentration [NOEC]). Accelerated testing will include the implementation of the initial investigation Toxicity Reduction Evaluation (TRE) workplan along with at least one additional toxicity test. If the investigation indicates the source of toxicity (e.g., a plant upset), and no toxicity greater than 143 TUc is observed in this test, the normal schedule of testing will be re-instated. If toxicity greater than 143 TUc is observed, then accelerated testing will continue with six more tests performed on a biweekly basis over a 12-week period. Testing will commence within two weeks of receipt of the sample results of the exceedence. If no toxicity greater than 143 TUc is observed in these tests, then the normal schedule of testing will be re-instated. If toxicity greater than 143 TUc is observed in any of the six tests, then a TRE will be initiated within 15 days of receipt of the sample results of the exceedence. A Toxicity Identification Evaluation (TIE) may also be initiated as part of the overall TRE process, and if this is initiated during the accelerated testing period, the accelerated testing schedule may be terminated or used as necessary in performing the TIE.

Toxicity testing was performed as described in Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms (EPA, 1988) and the West Coast Marine Methods Manual, First Edition (EPA,1995) as required by the permit. The presence of chronic toxicity was estimated as described by these references. Quality assurance for the toxicity testing included the testing of a series of five dilutions and a control, including the concentration of the effluent at the edge of the ZID (0.70 %) as well as two dilutions above and two dilutions below 0.70 %. Reference toxicants were tested concurrently with the effluent testing, using the same procedures. If the effluent tests did not meet all the acceptability criteria as specified in the referenced methods, then the effluent was re-sampled and re-tested as soon as possible. Control and dilution water was natural or synthetic seawater as called for by the referenced methods. If the dilution water was different from the culture water, a second control using culture water will be run. Dilution water met test acceptability criteria.

As part of the WET testing, an initial investigation TRE plan was prepared and submitted to EPA under separate cover (Kinnetic Laboratories, Inc., 2000b). This plan describes the events that will occur should chronic toxicity be detected. As required by the permit and the manual Toxicity Reduction Evaluation Guidance for Municipal Wastewater Treatment Plants (EPA, 1999b), a preliminary TRE will be initiated within 15 days of the receipt of sample results of the permit exceedence. A more detailed TRE workplan will subsequently be developed to more

fully investigate and identify the cause of the toxicity, identify and provide a schedule of the actions that AWWU will use to mitigate the impact of the discharge, and to prevent the recurrence of the toxicity. As noted above, the TIE may be initiated as part of the overall TRE process during the accelerated testing schedule.

2.1.5 Part 503 Sludge Monitoring

Operations at the Asplund WPCF include a sludge incinerator that is subject to regulation under 40 CFR Part 503—Standards for the Use or Disposal of Sewage Sludge (Part 503). The current permit requires sludge monitoring twice per year, once during the dry conditions in summer and once during wet conditions as noted above. There are no Part 503 monitoring requirements included in the reissued permit because EPA Region 10's current policy is to remove these requirements from NPDES permits with the intention of writing "sludge only" permits in the future. However, the Part 503 regulations are "self-implementing" in that the facility is required to meet the monitoring requirements in the regulation whether they are specifically included in a permit or not. Therefore, monitoring at the Asplund WPCF includes Part 503 monitoring of sludge. Monitoring frequencies required by 40 CFR Part 503 for incineration are once per 60 days for arsenic, cadmium, chromium, lead, and nickel. Frequency required for mercury is at least once per year. Frequency for beryllium is not specified. AWWU has chosen to also test mercury and beryllium once per 60 days, more frequently than required, so as to be consistent with the testing frequency for the other metals. Allowable limits are site-specific and were calculated per Part 503 regulation in the *Air Operating Permit Application* submitted by AWWU to ADEC in December 1997 (CH2M Hill, 1997). While methods for this monitoring component have been described elsewhere (AWWU, 2000) and results of the monitoring have been provided under separate reporting requirements to EPA, the data are also included in this report.

2.2 RECEIVING WATER QUALITY MONITORING

2.2.1 Water Quality Sampling

- ✓ determine compliance with the NPDES permit and State of Alaska water quality criteria
- ✓ aid in assessing the water quality at the discharge point
- ✓ determine compliance with the regulatory criteria of Section 301(h) for the CWA
- ✓ determine the level of bacterial contamination in nearshore waters
- ✓ provide data for evaluation of permit re-issuance

As called for by the permit, water quality must be monitored annually during the summer in dry weather conditions (Table 1). Sampling was performed at non-fixed stations made during consecutive ebb and flood tides at the outfall station and a single flood tide at the control station. Station locations were determined by following the track of drogues released above the diffuser at the outfall station and at the control station located north across Knik Arm from Point Woronzof, directly off Point MacKenzie in a similar water depth as the outfall. Three drogue tracks on the each tide were performed at each location. Four stations were sampled on each drogue track:

- above the diffuser
- as close to the ZID boundary as practicable
- at least one station in the channel of Knik Arm
- in the shallow subtidal area before the drogue grounds.

As noted in the permit, the ZID is defined as the water column above the area delineated by the sector of a circle with the center located over the outfall, 30 meters (m) shoreward of the diffuser, 650 m in radius, and with a 220˚ angle (Figure 3).

The plume location was followed by using a holey-sock drogue (Figure 4). The drogue consisted of a six-foot cylindrical nylon tube ballasted at the bottom with a five-pound weight and attached at the top with a bridle to a spherical float. This float attached to the tracking spar via a connecting line. These cylindrical or spherical designs that enclose a parcel of water have been found to more accurately follow the ambient current patterns than other drogue designs such as the window shade design (Sombardier and Niiler, 1994).

Sampling was performed by positioning the vessel over the diffuser (or control station) for the first sampling station of the drogue track. The drogue was released at approximately the same time and followed until navigation information indicated that the ZID has been reached, at approximately 650 m from the outfall, at which time the ZID boundary station was sampled. The third and fourth stations along each drogue track were sampled as the drogue traveled through the channel in Knik Arm and as it slowed in shallow water prior to grounding. Navigation was accomplished using a differential global positioning system (DGPS). If DGPS coordinates were unavailable, a standard GPS receiver was used to obtain navigational information. Range and bearing to fixed landmarks on shore using the vessel's radar may also have been recorded to aid in station positioning.

Samples were collected for the parameters outlined in Table 5. The surface waters of all stations were sampled for fecal coliform, color, and TRC. Surface samples were collected by grabbing directly into the appropriate sample bottles at sample depth (15 - 30 centimeters [cm]). Turbidity samples were collected at all stations from surface (0.5 m), mid-, and bottom depths using Niskin® bottles. Mid- and bottom depths were determined at each station using the survey vessel's fathometer. Samples were collected as simultaneously as possible at all three target depths. Hydrographic profiles of temperature, salinity, and pH were collected at all stations using a Seabird SEACAT® CTD (conductivity, temperature, and depth) sensor. This instrument was also equipped with a DO sensor to allow DO profiles to be recorded. Samples for the analysis of total and dissolved metals, TSS, hydrocarbons (PAH and AHC), and volatile aromatic hydrocarbons were collected from surface waters at the first three stations (diffuser, ZID boundary, and channel) along the first flood drogue track at both the outfall and control stations. These samples were collected directly into the appropriate sample containers. A single replicate sample for each parameter or a single profile was collected at each station except for quality control samples, which are described in Section 4.2.

Samples were analyzed following the methods provided in Table 6. Samples were appropriately labeled at time of collection using pre-prepared, project-specific sample labels as described in Section 2.4 and prepared for shipment to the laboratory. Preservation and maximum holding time information for each of these methods is also provided in Table 6. All sample containers were immediately placed on gel ice after sampling. Samples remained chilled as required during shipment to the analytical laboratory.

2.2.2 Intertidal Bacterial Sampling

As part of the water quality monitoring effort, intertidal sampling for fecal coliform bacteria was also performed at eight intertidal stations provided in Table 7 and depicted in Figure 3. Two

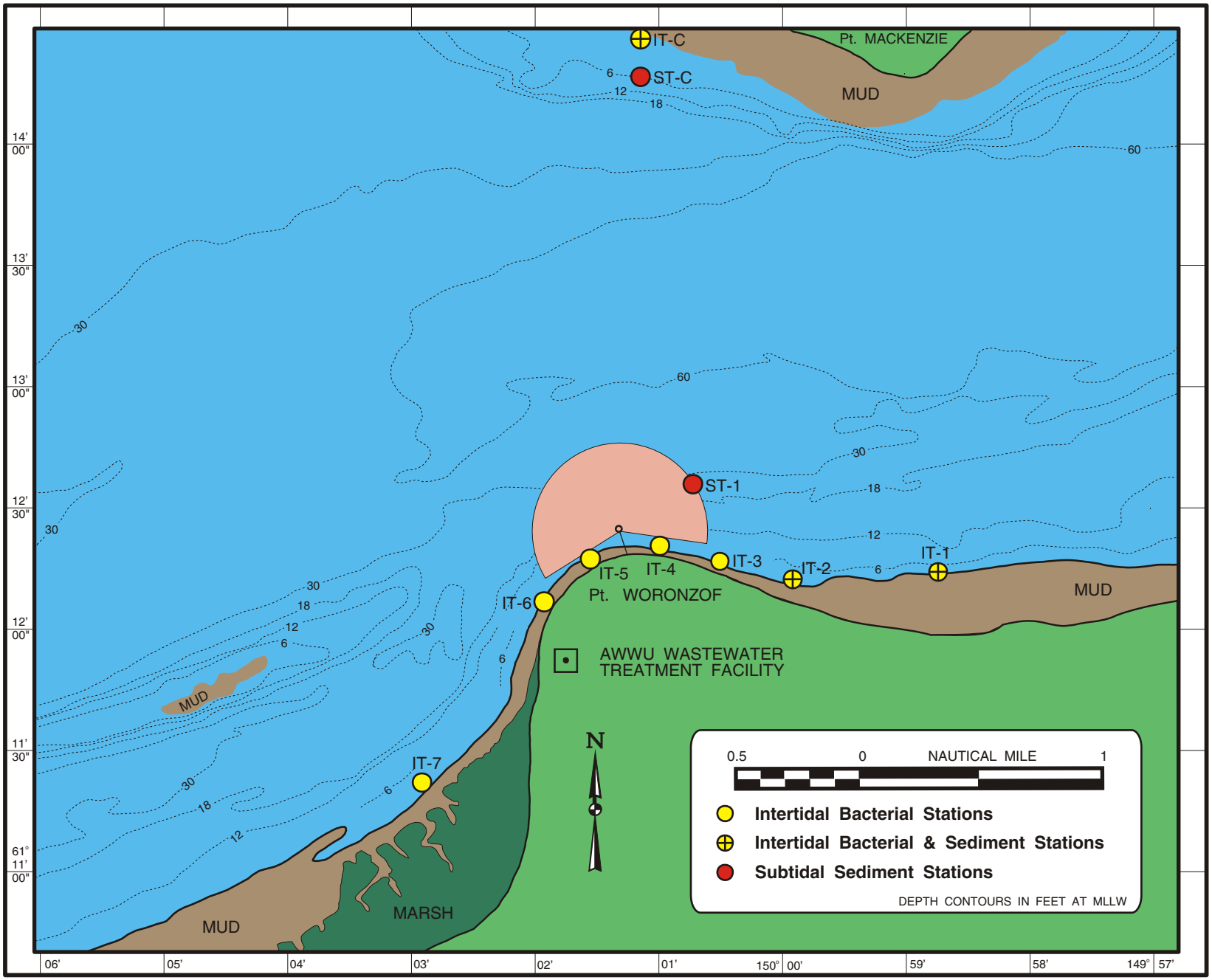


Figure 3. Asplund WPCF Outfall, ZID, and Locations of Intertidal and Subtidal Sampling.

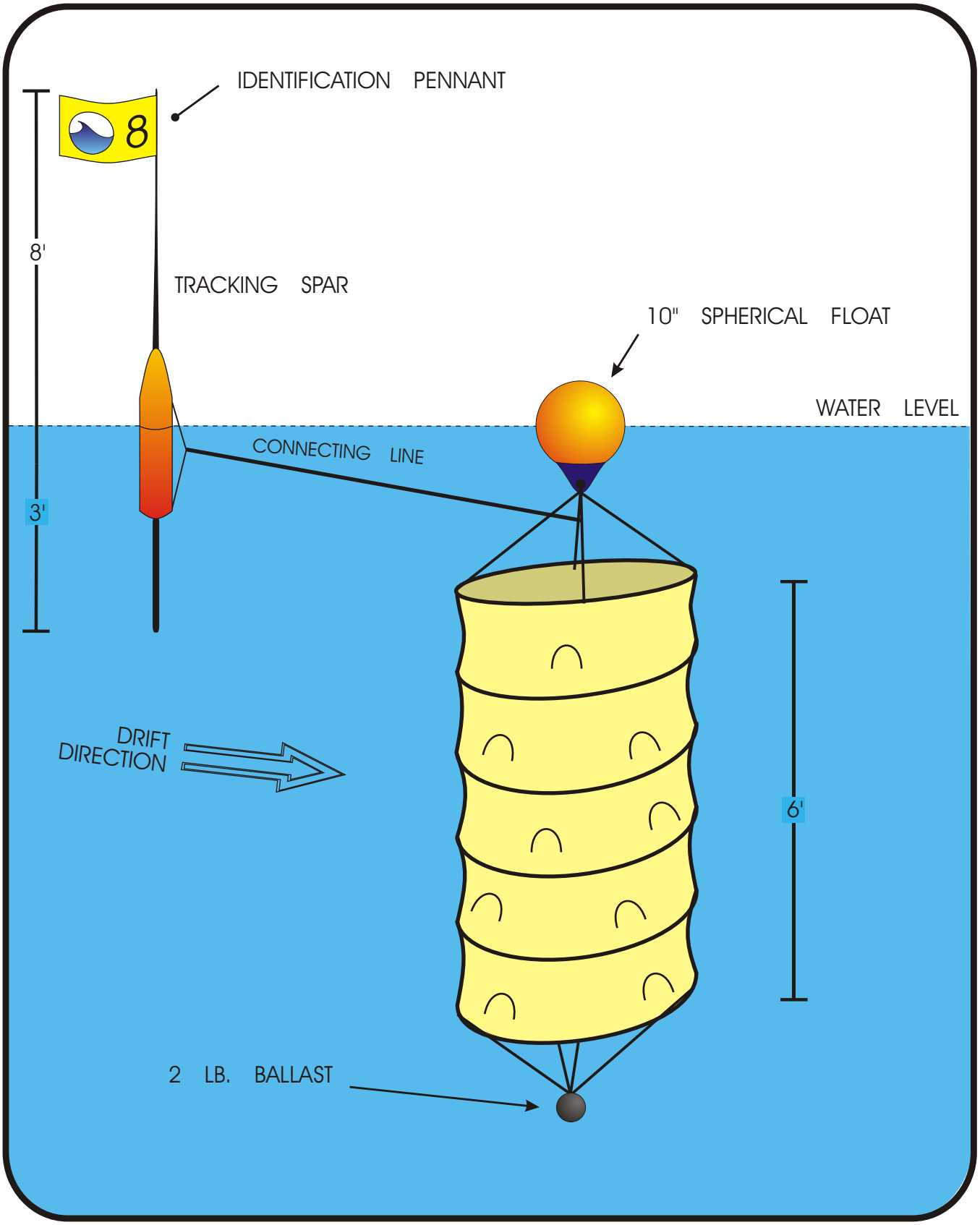


Figure 4. Holey-Sock Drogue, Flotation, and Marker Buoy.

Table 5. Receiving Water Quality Monitoring Requirements.

Parameter	Sampling Depth		
	Surface (above 0.5 m)	**Surface, Mid-, and Bottom**	**Profile (1- to 3-m intervals)**
Fecal Coliform	all stations[a], within the 15-30 cm layer		
Color	all stations		
Total Residual Chlorine (TRC)			
Field Observations: presence or absence of floating solids, visible foam (other than trace), oil wastes, and/or sheen	all stations where surface samples are collected		
Total Aqueous Hydrocarbons (TAqH)	first three stations along the first flood drogue track at both the outfall and control locations		
Total Aromatic Hydrocarbons (TAH)			
Metals and Cyanide[b]			
Total Suspended Solids (TSS)			
Turbidity		all stations	
Dissolved Oxygen (DO)			
pH			all stations
Temperature			
Salinity			

[a] Non-fixed stations will be sampled following the track of drogues released at the diffuser (outfall station) or at a fixed station having the same depth due north across Knik Arm from Point Woronzof near Point MacKenzie (control station). Three drogue tracks will be made during each of a consecutive flood and ebb tide at the outfall station. Three drogue tracks will be made during a flood tide at the control station in conjunction with or as soon as practicable as the sampling at the outfall station. Stations will include the following along each drogue track: above the diffuser; as close to the ZID boundary as possible; at least one station in the channel in Knik Arm; and the shallow subtidal area (before the drogue grounds).

[b] Metals include arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc will be analyzed and reported as total recoverable metals and dissolved metals.

Table 6. Methods, Preservation, and Maximum Holding Times for the Analysis of Receiving Water Quality Samples.

Parameter	Method[a]	Preservation	Maximum Holding Time
Fecal Coliform	SM 9221E	Cool, 4°C, dark	24 hours
Color	SM 2120B	Cool, 4°C, dark	48 hours
Total Residual Chlorine (TRC)	SM 4500-Cl D	None	Analyze immediately
Turbidity	SM 2130B	Cool, 4°C, dark	24 hours
Total Aqueous Hydrocarbons (TAqH)	EPA 602 plus xylenes	Cool, 4°C, HCl to pH<2, $Na_2S_2O_3$ in presence of chlorine	14 days
	EPA 610	Cool, 4°C, dark, $Na_2S_2O_3$ in presence of chlorine	7 days until extraction 40 days after extraction
Total Aromatic Hydrocarbons (TAH)	EPA 602	Cool, 4°C, HCl to pH<2 $Na_2S_2O_3$ in presence of chlorine	14 days
Metals (Total Recoverable and Dissolved)	See note [b]	Cool, 4°C, HNO_3 to pH <2 (after filtration for dissolved)	28 days
Cyanide	EPA 335.3	NaOH, 4°C	14 days
Total Suspended Solids (TSS)	EPA 160.2	Cool, 4°C	7 days
Dissolved Oxygen (DO)	SM 4500-O G (electrode)	None	*in situ*
pH	SM 4500-H^+ B	None	*in situ*
Temperature	SM 2550B[c]	None	*in situ*
Salinity	SM 2520B[c]	None	*in situ*

[a] "EPA" refers to the EPA document *Methods for Chemical Analysis of Water and Wastes*, revised March 1983, Document No. EPA-600/4-79-020, or 40 CFR 136. "SM" refers to *Standard Methods for the Examination of Water and Wastewater*, 18th ed., 1992.

[b] Dissolved metals will be filtered before acidification; total recoverable metals will be digested by ASTM Method D4309-91. Cadmium, chromium, copper, nickel, lead, and zinc will be subject to pre-concentration by chelation following EPA Method 1640 prior to analysis by inductively coupled plasma mass spectroscopy. These metals, along with antimony, beryllium, selenium, and thallium, will be analyzed as total recoverable and dissolved metals as appropriate for ICP/MS (EPA Method 1638). Mercury will be analyzed using cold vapor atomic fluorescence following EPA Method 1631. Arsenic will be determined in all samples by flame ionization atomic spectroscopy (SW846 Method 7062). Silver will be determined by graphite furnace atomic absorption (EPA Method 200.9).

[c] Modified for *in situ* measurements collected with the CTD.

Table 7. Approximate Locations of Intertidal Bacteria Sampling Stations.

Station	Station Location Relative to Diffuser	Latitude (N)	Longitude (W)
IT-1	2000 m east	61° 12' 10"	149° 58' 55"
IT-2	1200 m east	61° 12' 11"	149° 59' 50"
IT-3	750 m east	61° 12' 15"	150° 00' 20"
IT-4	250 m east-southeast	61° 12' 19"	150° 00' 52"
IT-5	250 m south	61° 12' 15"	150° 01' 10"
IT-6	750 m southwest	61° 12' 02"	150° 01' 28"
IT-7	2000 m southwest	61° 11' 22"	150° 02' 02"
IT-C	Across Knik Arm from the diffuser	61° 14' 26"	150° 01' 09"

replicate water samples were collected from each station at slack high water when the water depths were between 1 to 3 feet (ft). Additional quality control samples were collected as described in Section 4.1. Samples were collected by grabbing from 15 - 30 cm depths directly into the appropriate container. Samples were analyzed using the same procedures described above and in Table 6.

In addition to the required intertidal samples, two replicated fecal coliform samples were also collected once during the water quality monitoring effort from three area streams that empty into Knik Arm: Ship, Chester, and Fish Creeks. Samples were analyzed using the same procedures described above and in Table 6.

At time of collection, all fecal coliform samples were appropriately labeled using pre-prepared, project-specific sample labels as described in Section 2.4. All samples were collected in the appropriate precleaned sample containers and preserved, if necessary, as described by the method. Samples were placed on gel ice immediately after sampling and remained chilled during transport to the laboratory. Field notes, including navigational and sampling information, were recorded on project-specific field logs. As required by the permit, field observations taken at each station included the presence or absence of floating solids, visible foam in other than trace amounts, oily wastes, or sheen. Weather observations were also recorded. All field documentation was reviewed by the field leader at the completion of the survey. Sample collection and shipment was documented using project-specific chain of custody forms as described in Section 2.4.

2.2.3 Vessel Support

The *NORTH FORTY*, a 26-ft KLI-owned survey vessel, was used for drogue tracking and water sampling in 2003. In addition, a 14-ft Zodiac® was used to retrieve grounded drogues and conduct intertidal bacteria sampling. The Zodiac® was also used to transport samples with short holding times (i.e., bacterial samples) ashore.

2.3 SEDIMENT AND BIOACCUMULATION MONITORING

As stipulated in the NPDES permit, sediment and bioaccumulation monitoring was to be performed during the fourth year after the effective date of the permit. Sampling was to be performed in conjunction with the receiving water sampling.

2.3.1 Intertidal Sediment Monitoring

As part of the sediment quality monitoring effort and as outlined in Table 8, three replicate intertidal sediment samples were collected at each of the three intertidal stations in conjunction with the receiving water monitoring effort. Replicate samples were located within a 10-meter circle at each station location. Teflon®-coated spoons were used to collect and composite the top 2 cm of surficial sediments from an approximate area of 1-m radius for each replicate. Sediments were analyzed for the parameters listed in Table 9.

Table 8. Approximate Locations of Sediment Sampling Stations.

Station Number	Station Location Relative to Diffuser	Latitude (North)	Longitude (West)
IT-1	Intertidal area 2000 m east	61° 12' 10"	149° 58' 55"
IT-2	Intertidal area 1200 m east	61° 12' 11"	149° 59' 50"
IT-C (Control)	Intertidal area north across Knik Arm from the diffuser near Point MacKenzie	61° 14' 26"	150° 01' 09"
ST-1	Subtidal station at the ZID boundary	61° 12' 20"	150° 00' 34"
ST-C (Control)	Subtidal station at similar depth as outfall, north across Knik Arm from the diffuser near Point MacKenzie	61° 14' 26"	150° 01' 09"

At time of collection, all intertidal sediment samples were appropriately labeled using pre-prepared, project-specific sample labels as described in Section 2.4. All samples were collected in the appropriate precleaned sample containers and preserved, if necessary, as described by the method. Samples were placed on gel ice immediately after sampling and remained chilled during transport to the laboratory. Field notes, including navigational and sampling information, were recorded on project-specific field logs. As required by the permit, field observations taken at each station included the presence or absence of floating solids, visible foam in other than trace amounts, oily wastes, or sheen. Weather observations were also recorded. All field documentation was reviewed by the field leader at the completion of the survey. Sample collection and shipment was documented using project-specific chain of custody forms as described in Section 2.4.

Table 9. Preservation and Analytical Procedures for Intertidal and Subtidal Sediments.

Parameter	Preservation	Maximum Holding Time	Method[a]
Volatile Organics	Cool, 4°C	14 days	SW 8260B
Semi-Volatile Organics	Cool, 4°C	14 days until extraction/40 days after extraction	SW 8270C
Total Volatile Solids (TVS) %	Cool, 4°C	7 days	EPA 160.4
Asbestos	Cool, 5°C	28 days	Polarized Light Microscopy (PLM)
Dioxins	Cool, 4°C	30 days until extraction/45 days after extraction	SW 8280A
Pesticides & PCBs	Cool, 4°C	14 days until extraction/40 days after extraction	SW 8141A/8081A
Particle Grain Size Distribution	Cool, 4°C	28 days	Plumb, 1981
Cyanide (total)	Cool, 4°C	14 days	EPA 9010
Arsenic	Cool, 4°C	6 months	EPA 6020/3050B
Beryllium	Cool, 4°C	6 months	EPA 6020/3050B
Cadmium	Cool, 4°C	6 months	EPA 6020/3050B
Chromium	Cool, 4°C	6 months	EPA 6020/3050B
Copper	Cool, 4°C	6 months	EPA 6020/3050B
Lead	Cool, 4°C	6 months	EPA 6020/3050B
Mercury	Cool, 4°C	6 months	EPA 7471A
Nickel	Cool, 4°C	6 months	EPA 6020/3050B
Selenium	Cool, 4°C	6 months	EPA 6020/3050B
Silver	Cool, 4°C	6 months	EPA 6020/3050B
Zinc	Cool, 4°C	6 months	EPA 6020/3050B
Antimony	Cool, 4°C	6 months	EPA 6020/3050B
Thallium	Cool, 4°C	6 months	EPA 6020/3050B

a Unless otherwise noted, "EPA" refers to the EPA document *Methods for Chemical Analysis of Water and Wastes*, revised March 1983, Document No. EPA-600/4-79-020; "SM" refers to *Standard Methods for the Examination of Water and Wastewater*, 18th ed., 1992. "SW" refers to the EPA Manual SW 846, *Test Methods for Evaluating Solid Waste.* 3rd Ed., 1986.

b EPA, 1995. Document No. EPA-821-B-94-004.

2.3.2 Subtidal Sediment Monitoring

As part of the water quality monitoring effort, and as called for in the permit, subtidal sediment samples were collected during 23 – 26 June 2003 in conjunction with the receiving water sampling. Station locations are outlined in Table 8 and shown in Figure 3. Due to the cobble substrate at both subtidal stations, van Veen grab samples could not be obtained. A pipe dredge was utilized to sample these stations. As described by the permit, sediment samples of gravel or cobble substrate were to be subject to gross grain size distribution analysis only. Samples consisting of finer substrates (silt and clay fractions) were required by the permit to be analyzed for the same parameters required for intertidal sediments, as outlined in Table 9.

At time of collection, all subtidal sediment samples (consisting of cobbles) were appropriately labeled using pre-prepared, project-specific sample labels as described in Section 2.4. Field notes, including navigational and sampling information, were recorded on project-specific field logs. As required by the permit, field observations taken at each station included the presence or absence of floating solids, visible foam in other than trace amounts, oily wastes, or sheen. Weather observations were also recorded. All field documentation was reviewed by the field leader at the completion of the survey.

2.3.3 Bioaccumulation Monitoring

Bioaccumulation monitoring described by the permit involves the collection of the intertidal yellow-green algae *Vaucheria* spp. at two intertidal stations (IT-1 and IT-C). At each station, ten replicate samples of the algae are to be collected at randomly-generated distances and bearings within a 10-m radius of the existing station. Algal samples are required to be subject to analyses of the same parameters as the sediment (Table 9) with the exception of grain size, TVS, and asbestos. As noted in Section 3.3.3, bioaccumulation monitoring was scheduled to be performed during 2003, but sufficient accumulations of algae were not present for sample collection. In consultation with the AWWU project manager, it was decided to conduct bioaccumulation sampling during 2004.

2.3.4 Vessel Support

The *NORTH FORTY* and 14-ft Zodiac® were used to support the sediment monitoring program performed in 2003.

2.4 LABORATORY ANALYSIS

Laboratory analyses of all samples for this program followed preservation and analysis procedures described by EPA-accepted protocols as referenced in this document (Table 4, Table 6, and Table 9). These procedures are fully described by the referenced documents and/or 40 CFR 136.

2.5 DOCUMENTATION PROCEDURES

All field and sampling data were recorded on appropriate pre-printed project-specific field data forms. Field data forms included drogue tracking forms, water sampling log forms, sample identification/chain of custody forms, and sample labels. These log forms were tailored to the

monitoring program to facilitate accurate and complete documentation of field activities. The field task leader was responsible for review and approval of all field documentation; this was completed as soon as possible after sampling.

Sampling logs included specific information such as station identification, sample identification numbers, navigational data, sampling or photographic observations, sampling depths, and collection date and time. Names of personnel performing the sampling were recorded on each log. Drogue tracking logs included station identification information along with navigational data to allow the track of each drogue to be determined and plotted. Pre-printed labels included such information as station designation, analysis type, date of collection, sampling personnel, and a pre-assigned sample identification number to uniquely identify each sample. Quality control samples were labeled as were regular environmental samples so as to be blind to the laboratory analysts.

Sample identification and integrity was ensured by a rigidly-enforced chain of custody program. Sample identification/chain of custody forms (COCs) provided specific information concerning the identification, handling, and shipment of samples.

Pertinent information from the sample label was transferred onto the COC, along with other information as required. COC forms were completed, signed by field personnel, and copied if needed. In some cases, where photocopying was not convenient or possible, two-part carbonless forms were used. The original of each COC form was packed with the samples in coolers for shipment to the laboratory. The field task leader retained a copy of each form for the field records and for tracking purposes should a shipment become lost or delayed. Upon receipt of the samples at the analytical laboratory, the laboratory sample custodian signed the samples in by checking all sample labels against the COC information and noting any discrepancies as well as sample condition (e.g., containers leaking or damaged during shipment). Internal sample tracking procedures at the laboratory were initiated immediately upon receipt of samples as described by each laboratory's standard operating procedure.

3.0 RESULTS

3.1 INFLUENT, EFFLUENT, AND SLUDGE MONITORING

3.1.1 Monthly Discharge Monitoring Data

Results of AWWU's daily, weekly, and monthly sampling of the wastewater treatment plant influent and effluent for non-metals are presented as monthly summaries in Table 10. Averages and percent removal rates are based on the 12-month period from January through December 2003.

Removal of BOD_5 averaged 36 % for the year, and removal of TSS averaged 80 % for the 12-month reporting period. These averages far exceed the minimum values required by the amendments to the Clean Water Act (40 CFR Part 125.60; Final Rule, 8/9/94), whereby dischargers with 301(h) waivers are required to remove 30 % of BOD_5 and 30 % of the suspended solids. The highest monthly average effluent BOD_5 was 170 mg/L, substantially less than the permit limitation of 240 mg/L. All of the BOD_5 values (daily, weekly, and monthly averages) reported for the calendar year 2003 met the permit limitations. Total suspended solids concentrations in the effluent were low and typical of those seen historically at the Asplund WPCF with the highest monthly average effluent concentration of 52 mg/L compared to the permit limit of 170 mg/L. The yearly TSS average was 48 mg/L. Weekly average and daily maximum TSS also met permit requirements.

The highest mean monthly fecal coliform bacteria count was 1,141 fecal coliform most probable number (FC MPN)/100 mL in July 2003, in excess of the permit limitation of 850 FC MPN/100 mL based on a geometric mean of at least five samples. With the exception of this one month, all other monthly mean values were at or below 470 FC MPN/100 mL, well below the permit limitation. The criterion of not more than 10 % of the samples analyzed should exceed 2,600 FC MPN/100 mL was met during all months in 2003 except June and July. In June, two of 14 samples (14 %) were reported to be above this limit, and in July, five of 15 samples (33 %) were above this limit. Exceedences resulted from the continuing adjustment of the Oxidation Reduction Potential chlorine feed control system, optimizing the process to minimize chlorine usage while assuring adequate fecal coliform kill. This chlorine feed control system is discussed below in Section 5.1.1. All fecal coliform exceedences were reported to EPA on the discharge monitoring reports (DMRs) as required. No other permit exceedences were noted.

The concentration of TRC averaged 0.26 mg/L for the year compared to the maximum daily permit limitation of 1.2 mg/L. The TRC daily maximum limit was not exceeded this year.

Although other parameters such as DO and temperature do not have permit limitations, ranges were typical of those seen historically. Dissolved oxygen in effluent exhibited monthly averages ranging from 3.8 to 6.3 mg/L and a yearly average of 4.9 mg/L. Temperature showed yearly averages of 13.6 and 14.0˚C in the influent and effluent, respectively.

The permit requirement that effluent pH remain between 6.5 and 8.5 standard units was always met, exhibiting a yearly range of 6.6 to 8.1 pH units. Monthly values for total ammonia in effluent ranged from 20.3 to 23.5 mg/L, with a yearly average of 21.8 mg/L. While there is no permit limitation on total ammonia, these values fell well below its MAEC.

Table 10. Discharge Monitoring Data for Influent and Effluent Non-Metals.

Month	Average Flow Rate (MGD)	Temperature Average (°C)		pH Minimum/ Maximum (pH)		TRC Average (mg/L)		DO Average (mg/L)		BOD_5 Average (mg/L)		Total Susp. Solids Average (mg/L)		Fecal Coliform Average (MPN/100 mL)		Total Ammonia (mg/L)	
		INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF
01/03	28.9	12.2	12.4	6.9/7.6	6.6/7.3	NA	0.36	NA	5.0	245	164	225	47	NA	52	NA	20.7
02/03	30.9	11.4	11.6	7.0/7.5	6.6//7.5	NA	0.40	NA	6.1	242	159	226	50	NA	56	NA	20.7
03/03	29.2	11.4	11.2	7.0/7.8	6.8/7.8	NA	0.40	NA	6.3	244	166	231	49	NA	86	NA	20.3
04/03	28.0	11.8	12.3	7.1/7.8	6.7/7.5	NA	0.57	NA	5.8	262	162	235	46	NA	38	NA	21.0
05/03	27.3	13.0	13.4	7.2/7.5	6.9/7.3	NA	0.14	NA	5.1	268	155	252	50	NA	127	NA	23.5
06/03	25.9	14.2	14.9	7.1/7.7	6.9/7.7	NA	0.09	NA	5.0	268	160	251	45	NA	470	NA	23.2
07/03	25.9	15.8	16.5	7.0/7.5	6.9/7.6	NA	0.07	NA	4.2	253	161	250	45	NA	1141	NA	21.4
08/03	27.0	16.1	17.1	7.0/7.6	6.8/7.3	NA	0.33	NA	4.2	269	170	252	46	NA	105	NA	23.5
09/03	27.1	16.1	16.7	7.0/7.6	6.9/7.3	NA	0.30	NA	5.1	254	164	238	44	NA	43	NA	22.2
10/03	29.5	15.0	15.3	7.1/7.5	7.0/7.5	NA	0.13	NA	4.2	228	150	227	47	NA	85	NA	22.1
11/03	28.6	13.5	13.7	7.0/7.8	6.8/7.9	NA	0.12	NA	3.8	237	157	223	52	NA	105	NA	21.8
12/03	28.0	12.4	12.9	7.0/7.6	6.9/8.1	NA	0.17	NA	3.8	252	168	215	49	NA	211	NA	20.6
Average	28.0	13.6	14.0	6.9/7.8[a]	6.6/8.1[a]	---	0.26	---	4.9	252	161	235	48	---	210	---	21.8
Percent Removal	---	---		---		---		---		36		80		---		---	

[a] Yearly (minimum-maximum)
NA Not analyzed (effluent only)
--- Not applicable

3.1.2 Toxic Pollutants and Pesticides Analyses

Toxic pollutant and pesticide monitoring for influent, effluent, and sludge was conducted on 25 – 26 June 2003 for summer-dry weather and 12 - 13 August 2003 for the summer wet sampling. Sampling was performed over a 24-hour period by AWWU personnel.

Results of the toxic pollutant and pesticide analyses are provided in Table 11 (June 2003) and Table 12 (August 2003). For semi-volatile (EPA Methods 625/8270C) organic compounds, volatile (EPA Methods 624/8260B) organic compounds, and pesticides (EPA Methods 608/8081 and 614/8141A), only those pollutants that were detected in the influent, effluent, or sludge are listed. Refer to Appendices A and B for a complete listing of toxic pollutants and pesticides analyzed. A number of the constituents were found only in the sludge. Pollutants found in the influent were often detected in the effluent, and vice versa. In general, pollutant concentrations were low and many of the concentrations reported for the two samplings were below detection limits.

Percent removal rates shown in these tables were computed from influent and effluent concentration values. Percent removal was only calculated for compounds where a concentration in the influent and/or effluent was reported at a level above the method detection limit (MDL) or method reporting limit (MRL). Compounds with estimated concentrations (denoted with a "J" qualifier) were not used for percent removal calculation unless a non-estimated concentration was also reported for that compound in the other type of sample (influent or effluent). The reported MDL or MRL was used for calculations where necessary (where a compound was reported as non-detect [ND]). Where several laboratory duplicate analyses were performed for a parameter, a percent removal is provided for each duplicate. For summed values, such as the total aromatic hydrocarbons as BETX from Method 602, the reporting limit was used for values reported as not detected (ND).

Some of the pollutant removal rates were actually negative values due to the higher concentrations found in the effluent or where a compound was detected in the effluent but not the influent. Both positive and negative removals can be caused by effluent samples being more homogenous due to mixing in the clarifiers, whereas detecting a point-source pollutant in the influent is more haphazard. Also, there is a residence time for the effluent in the plant, along with the addition of approximately 1 million gallons/day of well water and city water in the treatment process, therefore the influent does not correspond directly with the effluent.

The types and concentrations of measured organic compounds varied considerably between the two sampling periods. Compounds that were detected in both the influent and effluent samples during at least one of the sampling events included bis(2-ethylhexyl) phthalate; diethyl phthalate, phenol, chloroform; methylene chloride; toluene; ethylbenzene; and xylenes. Bis(2-ethylhexyl) phthalate was also seen in the method blank in June 2003 and is a common laboratory contaminant, as noted in the past (see Section 4). Methylene chloride, another common laboratory contaminant, was seen in the field blanks, and these data were appropriately qualified with a B. With the exception of phenol and xylenes, these compounds were not detected in the sludge during the June 2003 sampling. Acenapthene, di-n-octyl phthalate, isophorone, and naphthalene were also detected in the sludge during June 2003. In August 2003, of those compounds that were detected in both the influent and effluent, only toluene, xylenes, and bis(2-

Table 11. Toxic Pollutants and Pesticides in the Influent, Effluent, and Sludge, Sampled 25 - 26 June 2003.

Pollutant	Influent[a] (µg/L)	Effluent[a,b] (µg/L)	Sludge[a] (µg/g)	Percent Removal
VOLATILES (EPA Methods 624/8260B) – detected substances only				
Bromomethane	ND (10)	7.0 J	ND (7.600)	30
Chloroform	2.5 J	3.8 J	ND (7.600)	-52
Methylene Chloride	7.9 B	4.1 B,J	ND (15000)	48
Toluene	12	7.4	ND (7600)	38
Xylenes (total)	ND (10)	5.1 J	7100 J	49
VOLATILES (SW 8021B/EPA 602 list)				
Benzene	ND(<1.0)	ND(<1.0) / ND(<1.0)	NT	--- / ---
Ethylbenzene	1.5	1.8 / 1.1	NT	-20 / 27
Toluene	9.9	5.8 / 6.4	NT	41 / 35
Xylenes	11	6.9 / 8.3	NT	37 / 25
SEMI-VOLATILES (EPA Methods 625/8270C) – detected substances only				
Acenaphthene	ND (10)	ND (10)	1.400	---
Bis (2-ethylhexyl) phthalate	18 B	18 B	ND (0.990)	0
Butyl benzyl phthalate	ND (10)	3.0 J	ND (0.990)	70
Di-n-butyl phthalate	ND (10)	1.6 J	ND (0.990)	84
Di-n-octyl phthalate	ND (10)	ND (10)	1.000	---
Diethyl phthalate	7.1 J	7.3 J	ND (0.990)	-9.9
Isophorone	ND (10)	ND (10)	3.700	---
Naphthalene	ND (10)	ND (10)	9.300	---
Phenol	30	18	3.300	40
HYDROCARBONS				
Oil & Grease (EPA 1664-HEM)	43400	24000	NT	45
Total Aromatic Hydrocarbons as BETX from EPA Method 602	23.4	15.5 / 16.8	NT	34 / 28
Total Aromatic Hydrocarbons as BETX from EPA Method 624	32	22.5	29.9	30

Table 11. Toxic Pollutants and Pesticides in the Influent, Effluent, and Sludge, Sampled 25 - 26 June 2003. (continued)

Pollutant	Influent[a] (µg/L)	Effluent[a,b] (µg/L)	Sludge[a] (µg/g)	Percent Removal
DISSOLVED METALS				
Antimony	ND (10)	ND (10)	NT	---
Arsenic	ND (<1.0)	ND (<1.0)	NT	---
Beryllium	ND (<0.1)	ND (<0.1)	NT	---
Cadmium	ND (<0.5)	ND (<0.5)	NT	---
Chromium	ND (<1.0)	ND (<1.0)	NT	---
Copper	19	27	NT	-42
Lead	7	7	NT	0
Mercury	0.07	0.05	NT	29
Nickel	2	3	NT	-50
Selenium	ND (10)	ND (10)	NT	---
Silver	0.9	0.6	NT	33
Thallium	ND (10)	ND (10)	NT	---
Zinc	ND (<30)	30	NT	0
TOTAL METALS				
Antimony	ND (10)	ND (10)	3.29	---
Arsenic	2	3	2.9	-50
Beryllium	ND (<0.1)	ND (<0.1)	0.19	---
Cadmium	0.5	ND (<0.5)	2.31	0
Chromium	3	7	17.3	-133
Copper	79	60	290	24
Lead	10	7	47.4	30
Mercury	0.19	0.13	1.6	32
Nickel	2	1	52.9	50
Selenium	ND (10)	ND (10)	2.41	---
Silver	4.3	3.3	17.20	23
Thallium	ND (10)	ND (10)	ND (0.943)	---
Zinc	100	70	582	30

Table 11. Toxic Pollutants and Pesticides in the Influent, Effluent, and Sludge, Sampled 25 - 26 June 2003. (continued)

Pollutant	Influent[a] (µg/L)	Effluent[a,b] (µg/L)	Sludge[a] (µg/g)	Percent Removal
PESTICIDES (EPA Methods 608/8081, 614/8141A) –detected substances only				
Malathion	ND (0.20) / ND (0.20)	0.31	ND (0.064)	-55 / -55
ENTEROCOCCI BACTERIA (SM 9230B)				
Enterococci[c]	NT	4900 / 6000	NT	---
OTHER COMPONENTS				
Asbestos[d]	ND (<71.00)	ND (<71.00)	ND	---
Cyanide	ND (10)	ND (10)	0.8	0
Dioxin (2,3,7,8-TCDD)	ND (0.00012)	ND (0.00027)	ND (0.00027)	---

a Detection limits or reporting limits are included in parentheses for non-detected (ND) values
b Duplicate field sample analysis or duplicate laboratory analysis provided (value/duplicate value)
c Enterococci reported in cfu/100 mL
d Asbestos reported in million fibers/L (influent and effluent) and present or none detected (sludge)
B Also detected in associated method blank or field blank
J Below MDL or MRL (estimated value)
--- Not applicable (not calculated)
ND None detected
NT Not tested

Table 12. Toxic Pollutants and Pesticides in the Influent, Effluent, and Sludge, Sampled 12 - 13 August 2003.

Pollutant	Influent[a] (µg/L)	Effluent[a,b] (µg/L)	Sludge[a] (µg/g)	Percent Removal
VOLATILES (EPA Methods 624/8260B) – detected substances only				
Chloroform	1.9 J	3.2 J	ND (0.079)	-68
1, 4-Dichlorobenzene	ND (5.0)	ND (5.0)	0.350	---
Ethylbenzene	ND (5.0)	ND (5.0)	0.110	---
Methylene chloride	3.3 B,J	2.9 B,J	ND (0.160)	12
Tetrachloroethene	ND (5.0)	ND (5.0)	0.180	---
Toluene	4.7 J	5.3	0.800	-13
Xylenes (total)	ND (10)	ND (10)	0.850	---
VOLATILES (SW 8021B 602 list)				
Benzene	ND (0.5)	ND (0.5) / ND (0.5)	NT	---/---
1,4 -Dichlorobenzene	1.4	1.2 / 1.2	NT	14 / 14
Ethylbenzene	ND (0.5)	1.1 / 1.3	NT	-120 / 160
Toluene	5.4	9.0 / 9.6	NT	-67 / -78
Xylenes	5.1	14 / 15	NT	-175 / -194
SEMI-VOLATILES (EPA Methods 625/8270C) – detected substances only				
Bis (2-ethylhexyl) phthalate	11/9.8	13	28	-18/-33
Di-n-butyl phthalate	ND(5.0)/ND(5.0)	ND(5.0)	1.9	---
Diethyl phthalate	9.9/9.9	11	ND (0.950)	-11/-11
Phenol	92/80.6	23	ND (0.950)	75/72
Pyrene	ND(5.0)/ND(5.0)	ND (5.0)	0.950	---/---
HYDROCARBONS				
Oil & Grease [c] (EPA 1664-HEM)	42200	20100	NT	52
Total Aromatic Hydrocarbons as BETX from EPA Method 602	11.5	24.6 / 26.4	NT	-114 / -130
Total Aromatic Hydrocarbons as BETX from EPA Method 624	24.7	25.3	NT	-2

Table 12. Toxic Pollutants and Pesticides in the Influent, Effluent, and Sludge, Sampled August 12 -13 2003. (continued)

Pollutant	Influent[a,b] (µg/L)	Effluent[a,b] (µg/L)	Sludge[a] (µg/g)	Percent Removal
DISSOLVED METALS				
Antimony	ND (1.0)/ND (1.0)	ND(1.0)/ND(1.0)/ND(1.0)	NT	---/---
Arsenic	2	4	NT	-100
Beryllium	ND(0.04)	ND(0.04)	NT	---
Cadmium	ND(0.5)	0.9	NT	-80
Chromium	1	1	NT	0
Copper	21	39	NT	-86
Lead	ND (1)	ND (1)	NT	---
Mercury	ND (0.1)	ND (0.1)	NT	---
Nickel	5	3	NT	40
Selenium	ND (1.0)	ND (1.0) / ND (1.0)	NT	---/---
Silver	ND(0.2)	ND(0.2)	NT	---
Thallium	ND (1.0)/ND (1.0)	ND(1.0)/ND(1.0)/ND(1.0)	NT	---/---
Zinc	19	69	NT	-263
TOTAL METALS				
Antimony	ND (1.0)	ND (1.0) / ND (1.0)	3.18	---/---
Arsenic	3	5	1.9	-67
Beryllium	0.11	0.07	0.23	36
Cadmium	0.8	0.7	2.40	12
Chromium	5	2	19	60
Copper	85	49	273	42
Lead	5	2	28.4	60
Mercury	0.3	0.1	2.13	67
Nickel	3	5	16	-67
Selenium	ND (1.0)	ND (1.0) / ND (1.0)	3.35	---/---
Silver	6.3	2.8	19.5	56
Thallium	ND (1.0)	ND (1.0) / ND (1.0)	ND (0.934)	---/---
Zinc	123	69	634	44

Table 12. Toxic Pollutants and Pesticides Detected in the Influent, Effluent, and Sludge, Sampled August 12 – 13 2003. (continued)

Pollutant	Influent[a,b] (µg/L)	Effluent[a,b] (µg/L)	Sludge[a] (µg/g)	Percent Removal
PESTICIDES (EPA 608/8081A, 614/8141A) – detected substances only				
All Compounds	ND	ND	ND	---
ENTEROCOCCI BACTERIA (SM 9230C)				
Enterococci[c]	NT	200 / 200	NT	---
OTHER COMPONENTS				
Asbestos[d]	ND (<71.00)	ND (<7.10)	ND	---
Cyanide	ND (10)	ND (10)	0.7	---
Dioxin (2,3,7,8-TCDD)	ND (0.0014)	ND (0.0012)	ND(0.00016)	---

a Detection limits or reporting limits are included where possible in parentheses for non-detected (ND) values
b Duplicate field sample analysis or duplicate laboratory analysis provided (value/duplicate value)
c O&G resampled 8/19/03, original sample failed QC
d Enterococci reported in cfu/100 mL
e Asbestos reported in million fibers/L (influent and effluent) and present or none detected (sludge)
--- Not applicable (not calculated)
B Also detected in associated method blank or field blank
ND None detected
NT Not tested
J Below MDL or MRL (estimated value)

ethylhexl) phthalate were seen in the sludge. In addition, 1,4-dichlorobenzene, ethylbenzene, tetrachloroethene, di-n-butyl phthalate, and pyrene were also detected in the sludge in August 2003.

Oil and grease concentrations measured in the influent and effluent in 2003 using EPA 1664 HEM were typical of that seen in the past with effluent concentrations in the range of 20 – 24 mg/L. BETX concentrations as measured by EPA 602 were 15.5 and 16.8 µg/L in the summer dry sampling and 24.6 and 26.4 µg/L during the summer wet sampling. BETX concentrations as measured by EPA 624 were 22.5 and 25.3 µg/L in the summer dry and summer wet sampling, respectively. Total aromatic hydrocarbons as BETX (EPA 602) and PAHs and AHCs were also sampled in the effluent as part of the receiving water program. Refer to Section 5.1 for further discussion of the significance of the total hydrocarbon values.

The AWQS have site-specific criteria for the Point Woronzof area that are based on dissolved metals in the receiving water. These SSWQC were utilized to determine the MAEC (the value specified as the receiving water limit and/or permit limit multiplied by the initial dilution of 142:1 for conservative substances and 180:1 for non-conservative substances after taking into account the natural background concentration). Both total and dissolved concentrations of metals in the effluent were then compared to the MAECs.

Total metals concentrations in the influent and effluent were generally found to be low. Effluent concentrations of total antimony, selenium, and thallium were below detection limits during both sampling periods. Total beryllium in both the influent and effluent was below detection limits in June 2003 but was reported at low levels in August 2003. Cadmium in effluent was reported as ND in June 2003 and at low levels in August 2003. Other total recoverable metals such as effluent chromium, copper, lead, mercury, nickel, silver, and zinc were seen in the effluent during both sampling events, but at very low levels when compared to their respective MAECs.

Dissolved metals concentrations for antimony, beryllium, selenium, and thallium were found to be below detection limits for both influent and effluent during both sampling periods. Dissolved lead, mercury, and silver were above detection limits in both influent and effluent in June 2003 but below detection limits in August 2003. Dissolved arsenic and chromium were reported at low levels for both influent and effluent during the August 2003 sampling period but were below detection limits in the June 2003 sampling. Cadmium was seen in the effluent in August 2003 but was below detection limits in the influent in August as well as during June 2003. The concentration for dissolved copper was found to be the highest of any of the metals with respect to its MAEC of 317 µg/L, but at 27 µg/L (June 2003) and 39 µg/L (August 2003), was still approximately an order of magnitude less than that limit. Dissolved nickel and zinc were also detected during both sampling periods at very low levels with respect to their MAECs.

No pesticides were detected in the influent, effluent, or sludge during the August 2003 sampling event. Malathion was detected in the effluent but not in the influent or sludge during June 2003. For a complete list of the various pesticide analytes, refer to Appendices A2 and B2.

The permit calls for the analysis of enterococci bacteria in effluent twice per year in conjunction with the summer dry and summer wet sampling. The enterococci in the effluent was reported as 4,900 and 6,000 colony forming units (cfu)/100 mL for the June 2003 sampling and 200 cfu/100 mL for both of the replicates taken during the August 2003 sampling event.

Asbestos was not detected in influent, effluent, or sludge during either sampling events. The concentrations of cyanide in influent and effluent were less than the detection limit of 10 µg/L during both the June and August 2003 sampling events as compared to an MAEC of 181 µg/L. Cyanide was detected in sludge at 0.8 and 0.7 µg/g during the two respective sampling events. Dioxin (2,3,7,8-TCDD) was tested in influent, effluent, and sludge during both sampling events, but none was detected.

3.1.3 Pretreatment Monitoring Data

As part of the NPDES permit, AWWU is to conduct pretreatment monitoring twice per year in conjunction with the toxic pollutant and pesticide analyses. This monitoring includes three consecutive days of 24-hr composite sampling of the influent and effluent. Pretreatment analyses include cyanide and a suite of metals that are analyzed as both total and dissolved. Results of the pretreatment monitoring are presented in Table 13.

Metals concentrations discussed in Section 3.1.2 as part of the toxic pollutant and pesticide analyses collected in June 2003 were actually collected on the second day of the pretreatment sampling for this period. Metals concentrations for the first day of the pretreatment sampling performed in August 2003 were discussed in Section 3.1.2. Metals concentrations for the two additional days of each pretreatment sampling event were typically similar to those discussed above, particularly for the effluent, but there was a fair amount of variability for some metals. Dissolved copper in the effluent was reported at 40 µg/L during the first day of pretreatment sampling in June 2003 and at 27 and 23 µg/L on the other two days of sampling. Dissolved copper in the effluent was more consistent during the August 2003 pretreatment sampling, with values reported at 39, 39, and 46 µg/L. Influent values were typically more variable than those seen in effluent, as would be expected.

Of all the metals, dissolved and total copper and zinc concentrations in the effluent were the highest, but these values were still well below their respective MAECs. Dissolved copper in the effluent was found to range from 23 to 46 µg/L for the six pretreatment samples compared to the MAEC of 317 µg/L. Total copper ranged from 49 - 65 µg/L during the pretreatment sampling. Dissolved zinc in the effluent ranged from 30 - 76 µg/L during both pretreatment samplings, while total zinc ranged from 69 to 100 µg/L as compared to an MAEC of 11,249 µg/L. Dissolved mercury was reported at ≤0.1 µg/L and total mercury was reported at <0.17 µg/L in all six effluent samples compared to the MAEC of 2.73 µg/L. Other metals were found to be substantially less than their respective MAECs. Total cyanide was below detection limits (<10 µg/L) in all six effluent samples compared to an MAEC of 181 µg/L.

3.1.4 Whole Effluent Toxicity Testing Results

Quarterly WET testing was conducted on 24-hr flow composite effluent samples as required under the permit during all four quarters of calendar year 2003. Bivalve survival and development tests were performed using the mussel *Mytilus galloprovincialis* during the first and second quarters of 2003. During the third quarter of 2003, screening tests were performed using one vertebrate and two invertebrate species to determine the most sensitive species, as called for by the permit. The vertebrate test was a 72-hr survival and growth bioassay on a topsmelt, *Atherinops affinis*. The invertebrate tests included a 48-hr survival and development test on a

Table 13. Pretreatment Monitoring Data for Influent and Effluent Metals and Cyanide. Concentrations are in µg/L.

Parameter	June 2003						August 2003					
	Influent			Effluent			Influent			Effluent		
Sample Date	**24**	**25**	**26**	**24**	**25**	**26**	**12**	**13**	**14**	**12**	**13**	**14**
Dissolved Metals												
Arsenic	<1	<1	<1	<1	<1	<1	2	3	3	4	4	2
Beryllium*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Cadmium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.9	0.9	<0.5
Chromium	<1	<1	<1	<1	<1	<1	1	1	1	1	2	1
Copper	23	19	22	40	27	23	21	23	21	39	39	46
Cyanide	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Lead	24	7	3	7	7	2	<1	<1	<1	<1	<1	<1
Mercury	0.14	0.07	0.08	0.06	0.05	0.06	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	4	2	2	2	3	3	5	3	6	3	5	3
Silver	1.4	0.9	1.0	0.7	0.6	0.8	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Zinc	<30	<30	<30	30	30	40	19	32	26	69	76	71
Total Metals												
Arsenic	2	2	1	2	3	1	3	5	5	5	5	2
Beryllium*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.11	0.07	0.10	0.07	0.11	0.08
Cadmium	0.7	0.5	0.6	<0.5	<0.5	<0.5	0.8	0.9	1.0	0.7	0.5	0.6
Chromium	6	3	2	3	7	4	5	9	6	2	2	2
Copper	110	79	80	65	60	58	85	80	94	49	54	55
Cyanide	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Lead	19	10	9	7	7	6	5	10	11	2	5	3
Mercury	0.38	0.19	0.34	0.10	0.13	0.17	0.3	0.2	0.2	0.1	0.1	0.1
Nickel	5	2	4	2	1	<1	3	3	6	5	4	13
Silver	6.7	4.3	5.1	3.6	3.3	3.6	6.3	5.7	5.6	2.8	3.9	2.7
Zinc	150	100	140	80	70	100	123	133	151	69	83	69

* Not required by permit
NT Not tested

bivalve mussel, *Mytilus galloprovincialis*, and a 24-hr echinoderm fertilization test on a purple sea urchin, *Strongylocentrotus purpuratus.* Bivalves exhibited a response in the development endpoint at the highest effluent concentration, therefore, and testing continued during the last quarter of 2003 utilizing the bivalve survival and development test, which was still considered to be the most sensitive.

Results of all the tests performed in 2003 are summarized below and presented in Table 14 as the lowest observed effect concentration (LOEC), no observed effect concentration (NOEC), and in chronic toxicity units (TUc), where TUc = 100/NOEC. Detailed results in the form of descriptive laboratory reports that present all data in tabular form along with statistical analyses, QA/QC information, and reference toxicant tests are presented in Appendix C.

Table 14. Summary of WET Test Data from 2003.

Toxicity Test	LOEC (%)	NOEC (%)	TUc
1st Quarter 2003			
Bivalve (survival)	>2.8	≥2.8	≤35.7
Bivalve (development)	>2.8	≥2.8	≤35.7
2nd Quarter 2003			
Bivalve (survival)	>2.8	≥2.8	≤35.7
Bivalve (development)	>2.8	≥2.8	≤35.7
3rd Quarter 2003			
Bivalve (survival)	>2.8	2.8	≤35.7
Bivalve (development)	**2.8**	**1.4**	**71.4**
Topsmelt (survival)	>2.8	2.8	35.7
Topsmelt (growth)	>2.8	2.8	35.7
Echinoderm (fertilization)	>2.8	2.8	35.7
4th Quarter 2003			
Bivalve (survival)	>2.8	≥2.8	≤35.7
Bivalve (development)	>2.8	≥2.8	≤35.7

Bolded values indicate statistically significant results indicating chronic toxicity.

First quarter 2003 bivalve survival and development testing was performed on a single 24-hr composite sample collected on 9 - 10 February 2003. Second quarter testing with bivalves was performed on an effluent sample collected on 14 – 15 April 2003. Third quarter WET testing for bivalve survival and development, topsmelt larval survival and growth, and echinoderm fertilization was performed on samples collected from 14 - 19 July 2003 and 2 - 3 September 2003. Fourth quarter sampling was conducted on a sample collected on 19 - 20 October 2003.

Results of the first, second, and third quarterly 2003 bivalve testing showed that no concentration of effluent tested produced significant mortality or significant decreased normal development of test organisms when compared to the controls. Results reported for these tests showed an LOEC of >2.8 %, an NOEC of ≥2.8 %, and a TUc of ≤35.7 for both survival and development. All test validity criteria were met and reference toxicant tests were within laboratory control chart limits which indicated typical sensitivity of the test populations for these tests.

Results of the bivalve testing performed during the third quarter of 2003 as part of the re-screening process as described in Section 2.1.4 was performed twice. Initial testing in July 2003 showed reduced development in control exposures, failing test acceptability criterion on 90 %. An attempt to rerun the test in July failed when the test population failed to spawn properly due to the seasonality of bivalve spawning. Resampling and retesting was performed in September 2003, when the test population proved to be more amenable to spawning. Results indicated that the highest effluent concentration tested resulted in significantly reduced normal development of the test organisms, although survival was not affected. The NOEC for normal development was 1.4 %, while the LOEC was 2.8 %. The TUc for development was reported at 71.4, well below the permit maximum of 143. The reported NOEC for survival was 2.8 %, the LOEC was >2.8 %, and the TUc was <35.7. These results were identical to that of the July bivalve testing which had failed to meet acceptability criteria and suggested that the bivalve testing was the most sensitive of the three species to this effluent. All test validity criteria were met and reference toxicant test results were within laboratory control chart limits for this bivalve bioassay, indicating valid tests and typical sensitivity for the test populations.

Results of the topsmelt larval survival and growth testing performed during the third quarter of 2003 showed that no effluent test concentration produced a significant mortality or a decrease in growth when compared to the controls. The LOEC for both survival and growth was >2.8 % and the NOEC was 2.8 %, with a TUc of 35.7. All test validity criteria were met and reference toxicant tests were within laboratory control chart limits which indicated typical sensitivity of the test populations for this test.

Results of the echinoderm fertilization test performed during third quarter 2003 showed that no concentration of effluent testing produced a significant decrease in egg fertilization compared to the controls. The LOEC was >2.8 % and the NOEC was 2.8 %, with a TUc of 35.7. All test validity criteria were met and reference toxicant tests were within laboratory control chart limits which indicated typical sensitivity of the test populations for this test.

3.1.5 Part 503 Sludge Monitoring Data

The AWWU operates a sludge incinerator at the Asplund WPCF for which the NPDES permit requires sludge monitoring twice per year as part of the "Toxic Pollutants and Pesticides/Pretreatment" sampling requirements. As described in Section 2.1.5, AWWU performed Part 503 sludge monitoring with a minimum frequency of once every 60 days. These data will be submitted along with other incinerator operational information to EPA by 19 February 2004. This submittal will take the form of a separate report; however, for completeness and for comparison purposes, this information has been included here as well.

Results of the sludge monitoring for metals for the year are presented in Table 15. Metals concentrations were extremely low compared to allowable limits and very similar to those seen

Table 15. Part 503 Discharge Monitoring Data for Sludge Metals. Concentrations are in mg/kg dry weight. All metals are reported as total metals.

Parameter	Arsenic	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel
MDL	0.2	0.02	0.08	3/0.2[b]	0.2	0.02	3/0.2 [b]
Permit Limit[a]	95.8	500[c]	66.6	2,466	7,707	9.63[d]	102,764
02/21/03	2.0	0.07	1.1	10	23	0.9	9
04/27/03	1.7	0.08	0.7	8	19	1.1	7
06/25/03	2.9	0.19	2.31	17.3	47	1.6	52.9
08/13/03	1.9	0.23	2.40	19	28	2.13	16
10/07/03	2.0	0.17	2.70	14	19	1.06	19
12/09/03	2.5	0.13	2.12	15.1	36	1.04	13.8
MINIMUM	1.7	0.07	0.7	8	19	0.9	7
MAXIMUM	2.9	0.23	2.7	19	47	2.1	53
AVERAGE	2.2	0.15	1.9	14	29	1.3	20

Footnotes:

MDL Method detection limit

[a] Permit Allowable Limits calculated in Air Operating Permit Application submitted to ADEC, December 1997.

[b] Chromium, and nickel were analyzed by the EPA 7191 and 7521 method respectively, on the 6/25/03 and 12/09/03 samples only.

[c] Beryllium emissions shall not exceed 10 grams per day. With a control efficiency of 0.9998 at the maximum sludge feed rate, a sludge concentration of 500 milligrams per dry kilogram of sludge will not result in a violation of the limit.

[d] Mercury emissions shall not exceed 3,200 grams per day. With a control efficiency of 0.0 at the maximum sludge feed rate, a sludge concentration of 9.63 milligrams per dry kilogram of sludge will not result in a violation of the limit.

historically. The only metal that had historically been elevated for some sampling events was arsenic. In 2003, the highest concentration of arsenic in the sludge was 2.9 mg/kg compared to the allowable limit of 95.8 mg/kg. As mentioned above, no permit limits exist in the reissued NPDES permit. Allowable limits are site-specific and were calculated per Part 503 regulations in the *Air Operating Permit Application* submitted by AWWU to the ADEC in December 1997 (CH2M Hill, 1987).

3.2 RECEIVING WATER QUALITY MONITORING RESULTS

Water quality sampling of the receiving water was conducted on 24 - 25 June 2003, concurrent with the summer dry sampling. Sampling results are contained in the following subsections.

3.2.1 Plume Dispersion Sampling

Drogue Tracking Results

Drogues were released on 24 June 2003 at the control station for the flood tidal cycle and on 25 June 2003 at the ZID station for the ebb and flood tidal cycles. Three drogues were deployed during each tidal cycle.

Control Site

The Point MacKenzie control drogues were deployed and tracked on 24 June 2003. The predicted tidal range during the flood tide was 20.7 ft. Tidal information is provided in Figure 5 and Table 16 (Micronautics, Inc. Tide 1: Rise and Fall®, 2003). A composite of the three drogue trajectories is presented in Figure 6.

All three control drogues had similar tracks with the first drogue (C1) tracking closer to shore. The first drogue was released at 11:25 Alaska Daylight Time (ADT), 19 minutes after slack water, and traveled to the northeast. After traveling approximately 2¼ nautical miles, the drogue reversed direction, traveling south west for about ¾ mile before being picked up at 13:07 ADT. The second drogue (C2) was released at 13:20 ADT, about 2¼ hours into the flood tidal cycle, and tracked until recovery at 15:52 ADT. This drogue had an average speed of 164 centimeters/second (cm/s) over the entire track and moved towards the northeast offshore of the first drogue and then northerly after passing Cairn Point. The third control drogue (C3) was released at 15:22 ADT, about 4¼ hours after high slack water. The drogue traveled in a manner similar to the second drogue, moving northeast into the central channel with an average speed of 197 cm/s. Abreast of Cairn Point, the drogue veered toward the western shore of Knik Arm, traveling in a north-north-west direction for the last half mile of its trajectory. The drogue was recovered at 17:00 ADT on the shoal on the far side of the Arm from Cairn Point.

ZID Site

The Point Woronzof ebb drogue drop and tracking cycles were performed on the morning of 25 June 2003. The tidal range during ebb stage was 24.7 feet (Figure 7 and Table 16; Micronautics, Inc. Tide 1: Rise and Fall®, 2003). A composite of the ebb drogue deployments is depicted in Figure 8.

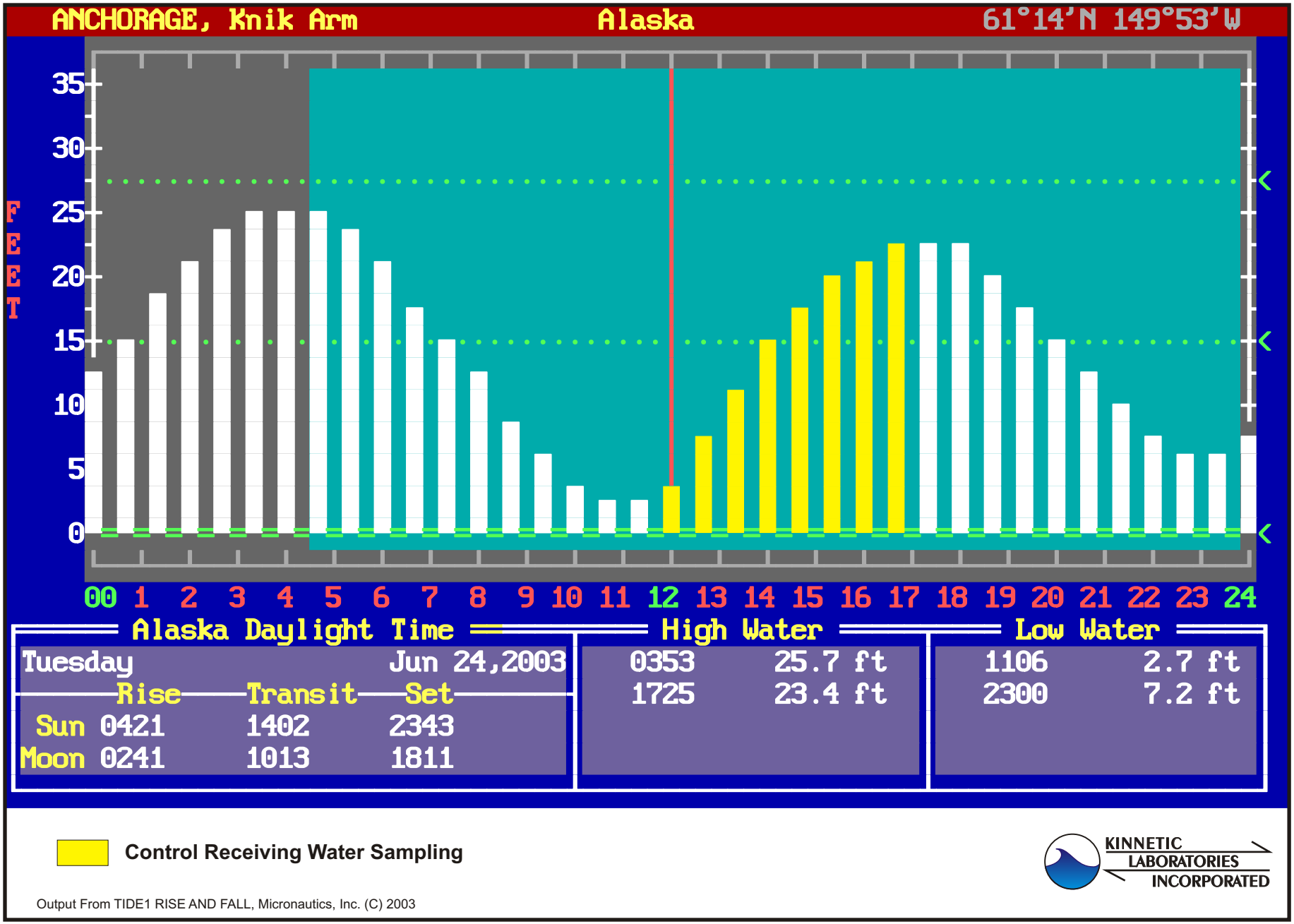


Figure 5. Tidal Information for Receiving Water Sampling, Control Tides.

Table 16. 2003 Drogue Tracking Information.

DATE	STATION	TIDAL INFORMATION				DROGUE NO.	RELEASE TIME AFTER SLACK (HOURS:MINUTES)	DROGUE SPEED (CM/S)
		Slack Water (Alaska Daylight Time[a]; Stage)		Direction	Range (Feet)[b]			
24 June 2003	CONTROL	11:06	LOW	FLOOD	20.68	C1	0:19	95
24 June 2003	CONTROL	11:06	LOW	FLOOD	20.68	C2	2:14	164
24 June 2003	CONTROL	11:06	LOW	FLOOD	20.68	C3	4:16	197
25 June 2003	ZID	04:50	HIGH	EBB	24.65	E1	0:31	104
25 June 2003	ZID	04:50	HIGH	EBB	24.65	E2	1:57	99
25 June 2003	ZID	04:50	HIGH	EBB	24.65	E3	3:48	94
25 June 2003	ZID	12:03	LOW	FLOOD	23.71	F1	0:03	58
25 June 2003	ZID	12:03	LOW	FLOOD	23.71	F2	1:52	46
25 June 2003	ZID	12:03	LOW	FLOOD	23.71	F3	4:04	106

a Tide1: Rise and Fall®, Micronautics, Inc. 2003. (Knik Arm, Anchorage)
b Predicted water level variations during tide.

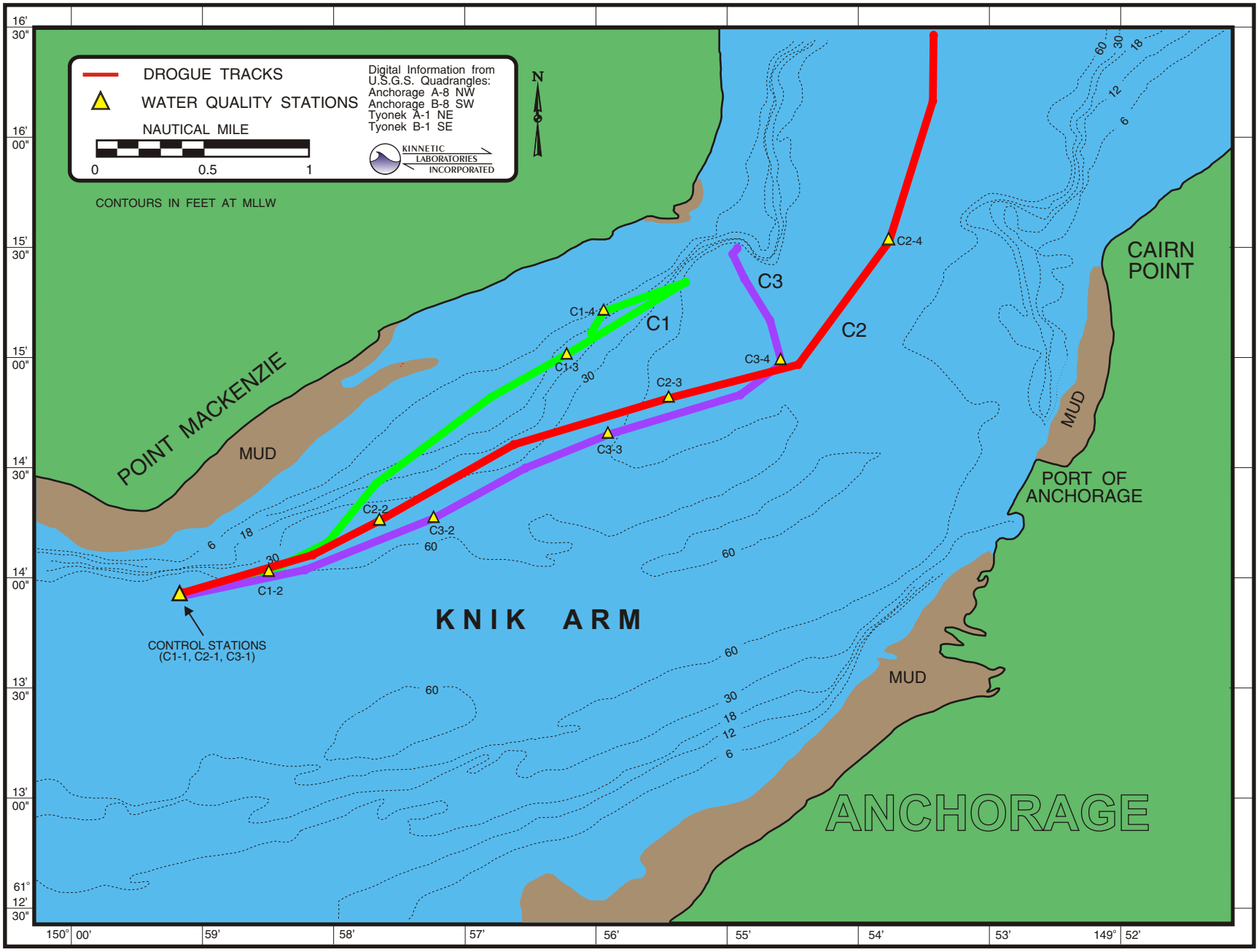


Figure 6. Summary of Control Drogue Tracks and Receiving Water Sampling Locations at Point MacKenzie, 24 June 2003.

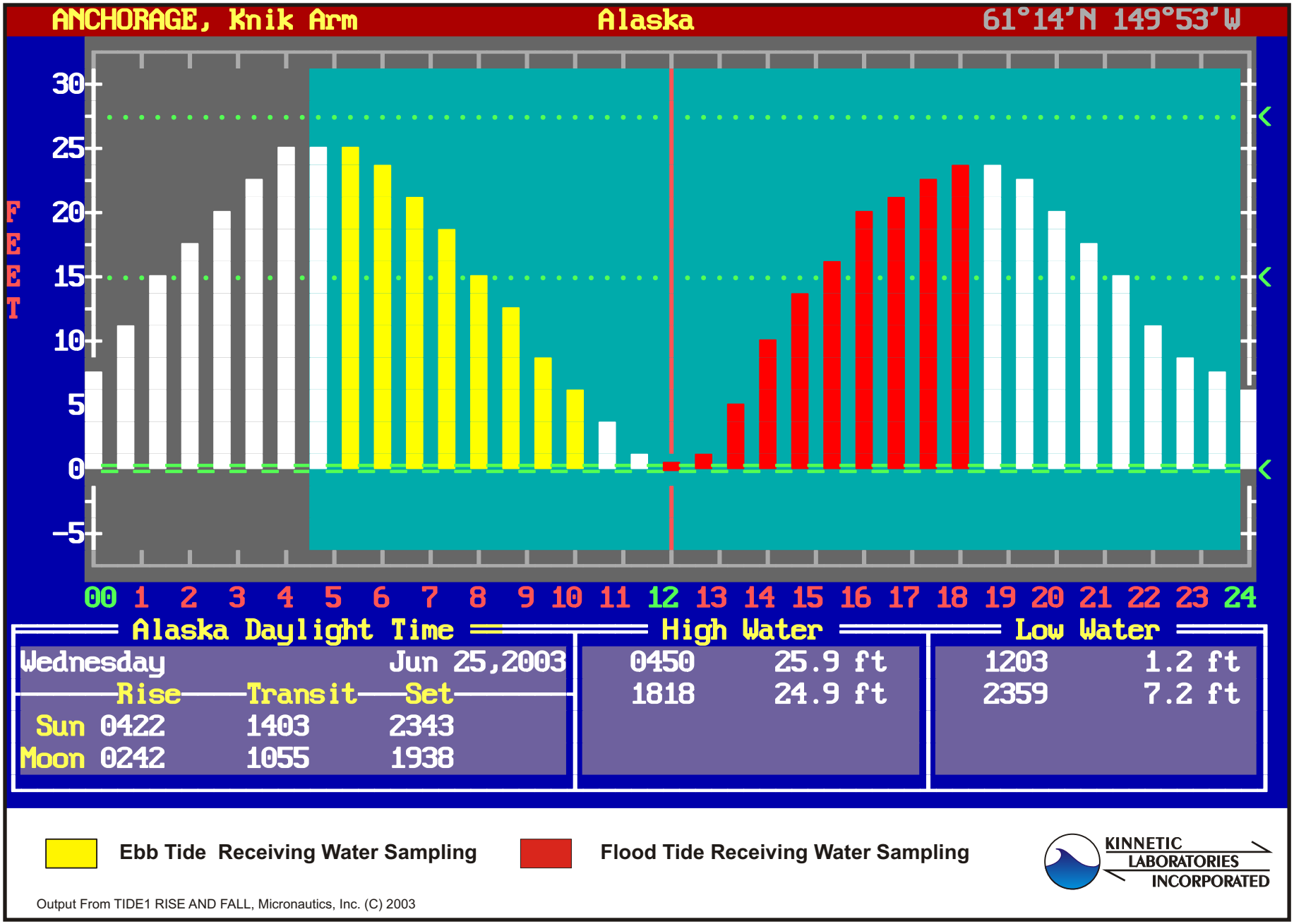


Figure 7. Tidal Information for Receiving Water Sampling, Ebb and Flood Tides.

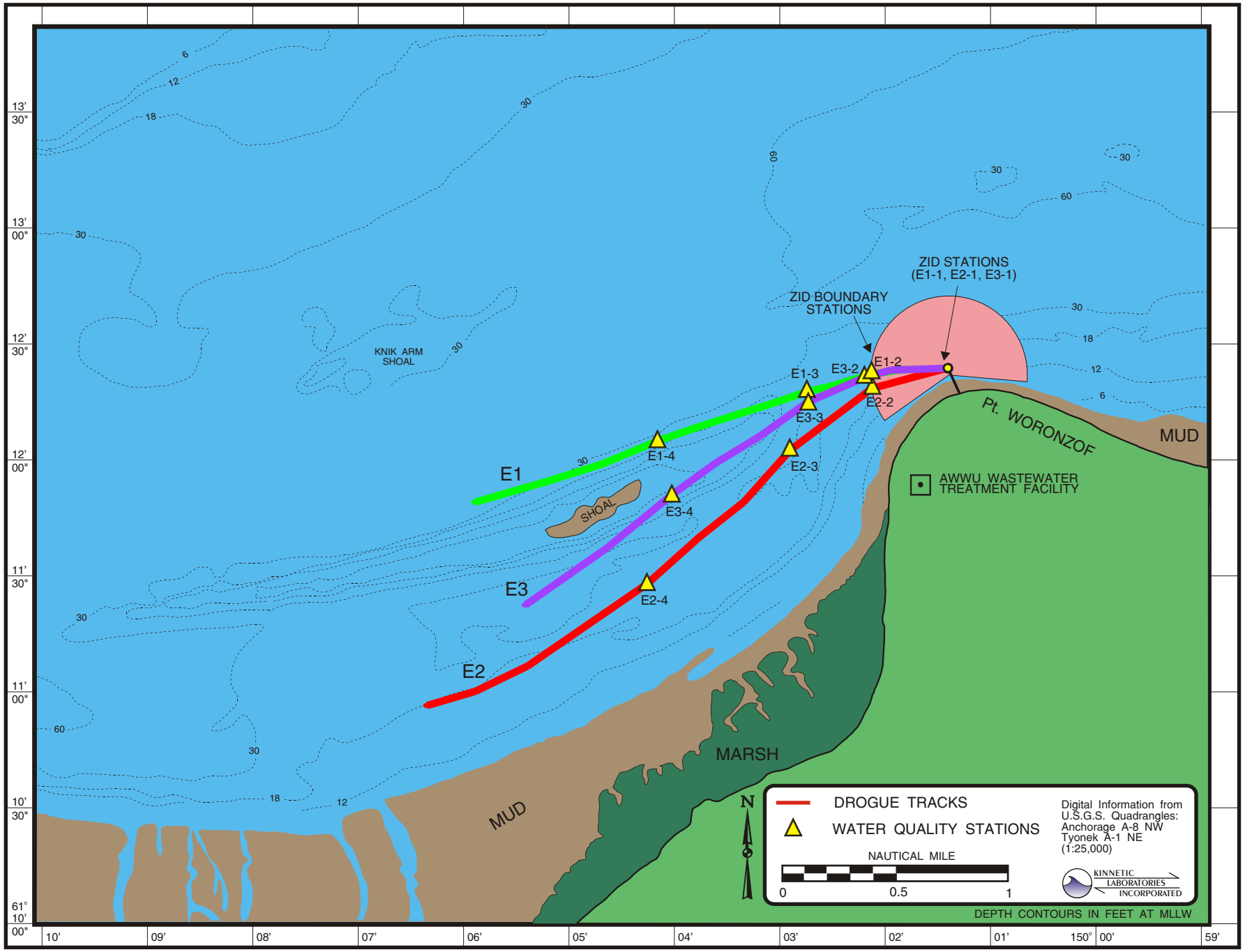


Figure 8. Summary of Ebb Drogue Tracks and Receiving Water Sampling Locations at Point Woronzof, 25 June 2003.

The waters of the inlet are extremely well-mixed both vertically and horizontally, as indicated by the CTD data. During the survey, temperatures ranged from a minimum of 13.24˚ C to a maximum of 14.13˚ C. Salinities were found to vary from a minimum of 9.7 parts per thousand (ppt) to a maximum of 15.41 ppt. Salinities were generally found to increase slightly during the flood and decrease on the ebb, as is typical for estuaries. The control stations across the inlet were slightly warmer than the ebb and flood stations and were less saline due to a greater influence from river runoff. Values for DO collected in-situ by the CTD ranged from 8.80 to 12.08 mg/L. As seen in Table 17, CTD data for Stations E2-4 and F3-1 (DO only) were not available due to malfunctions of the CTD.

The ebb drogues traveled from approximately 2 to 2½ nautical miles, all three traveling in a southwesterly direction. No eddies were observed during these drogue tracks, nor did any of the drogues become grounded during their tracks. The first ebb (E1) drogue was released at 05:29 ADT, about ½ hour after high tide. This drogue tracked west-south-west and well north of the shoal that is evident at low water approximately one mile southwest of Point Woronzof. This drogue traveled at approximately 104 cm/s over its entire track of about 2 nautical miles. The second ebb drogue (E2) was released at 06:47 ADT and tracked much closer to shore, well south of the shoal, traveling nearly 2½ nautical mile with an average speed of 99 cm/s over the entire track. The third drogue (E3) was released at 08:38 ADT. This drogue began its track similar to the first drogue, then veered more to the south and passed to the south of the shoal. This drogue traveled about 2 miles at approximately 94 cm/s over its entire track.

Flood drogue tracks are depicted in Figure 9. The tidal range during flood stage was 23.7 feet (Figure 7 and Table 16; Micronautics, Inc. Tide 1: Rise and Fall®, 2003). The first flood drogue (F1) was deployed on 25 June at 12:06 ADT at low slack water at the outfall and tracked until 13:42 ADT, at which point it was recovered. This drogue traveled easterly along the shoreline on the lee side of Point Woronzof for about 1¼ nautical miles. The drogue traveled at an average speed of approximately 58 cm/s. The second flood drogue (F2) was deployed at 13:55 ADT, almost 2 hours after low slack. This drogue was transported to the east for about one nautical mile and then slowly looped in an eddy toward shore, then north, finally traveling east for about ¼ mile before it was recovered at 15:55 ADT. This drogue had an average speed of 46 cm/s. The third flood drogue (F3) was deployed at 16:07 ADT, about 4 hours after low slack water, and tracked for about 2 hours until recovery at 18:10 ADT. The third drogue traveled in a northeast direction further out from the shoreline, with an average speed of 106 cm/s. The third drogue was tracked for approximately 4½ nautical miles to the northeast and was recovered offshore and to the west of the Port of Anchorage.

Summary of Water Quality Data

The summer water quality sampling for all analysis types was conducted concurrently with the drogue tracking studies on 24 – 25 June 2003. As discussed previously, three drogues were released at the control site for the flood tide and three were released at the ZID for both ebb and flood tides. Water samples and CTD measurements were to be obtained at four stations along each drogue's track prior to its grounding. In the current NPDES permit, the ZID boundary is located 650 m distance from the outfall diffuser. To accomplish the ZID site sampling, the vessel was positioned directly upcurrent from the diffuser and allowed to drift down across it. Upon reaching the outfall diffuser, the drogue was dropped and the within-ZID station sampled. The distance from the outfall diffuser was monitored with the DGPS, and upon

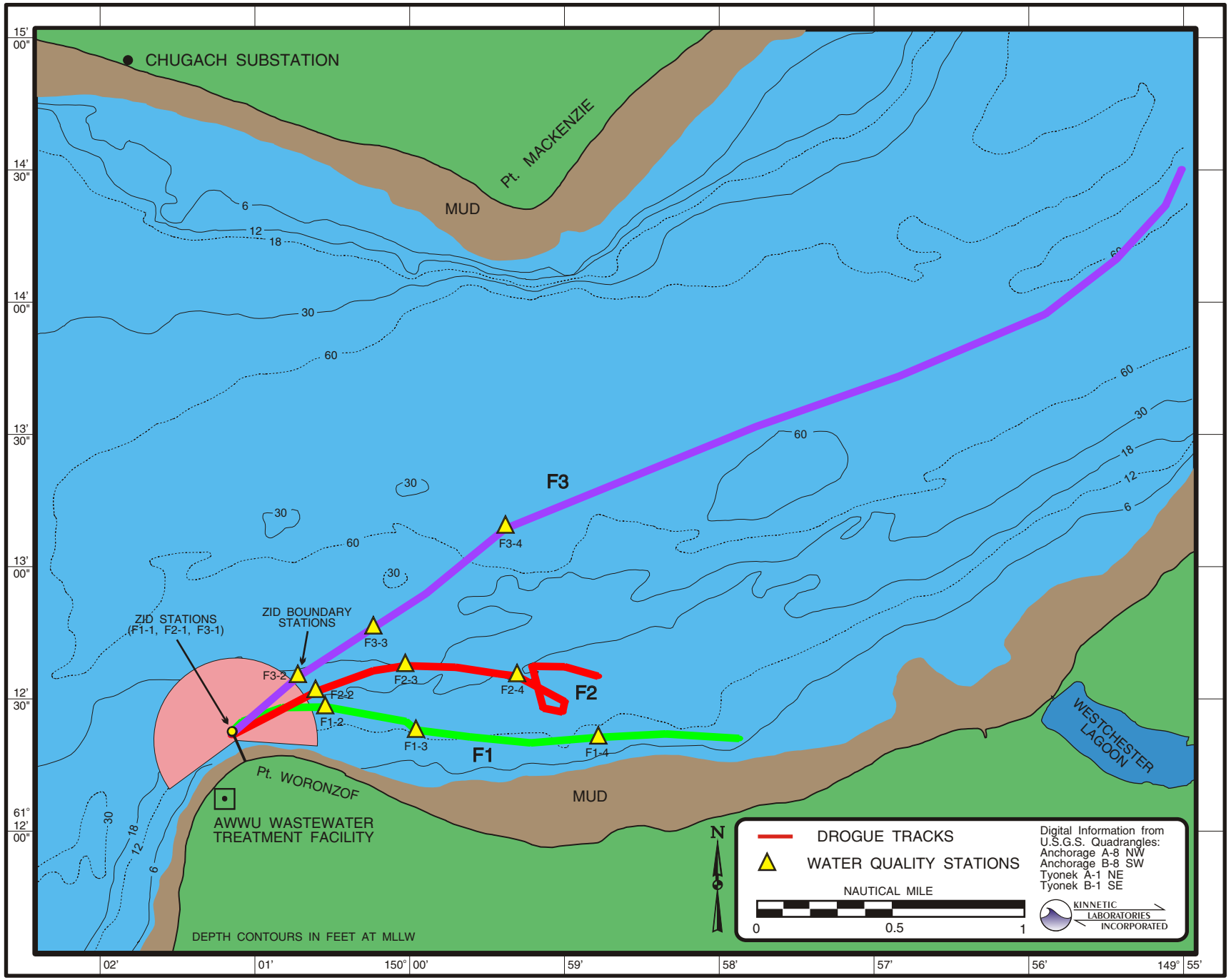


Figure 9. Summary of Flood Drogue Tracks and Receiving Water Sampling Locations at Point Woronzof, 25 June 2003.

Table 17. Hydrographic and Water Quality Data, 24 and 25 June 2003.

Station Number	Time (ADT)	Latitude (North)	Longitude (West)	Depth (M)	Temp[b] (˚C)	Salinity[b] (‰)	pH[b] (units)	D.O.[b] (mg/L)	Turbidity (NTU)	Color (units)	TRC (mg/L)	Fecal Coliform[a]
					JUNE 24							
C1-1S	1125	61° 13.947 ’	149° 59.123’	0.5	13.69	11.03	7.82	8.85	35	<5	<0.005	4
-1M				3.5	13.69	11.37	7.82	8.82	191			
-1B				7.0	13.69	11.54	7.81	8.80	199 / 211			
C1-2S	1140	61° 14.051’	149° 58.441’	0.5	14.06	10.05	7.78	9.21	34	<5	<0.005	4
-2M				6.5	13.98	10.63	7.84	9.22	223			
-2B				12.5	13.69	11.44	7.85	9.27	321			
C1-3S	1220	61° 15.041’	149° 56.166’	0.5	13.89	10.53	7.79	9.42	172	<5	<0.005	<2
-3M				4.0	13.86	10.54	7.84	9.45	176			
-3B				7.5	13.84	10.55	7.83	9.50	232			
C1-4S	1302	61° 15.233’	149° 55.892’	0.5	13.72	9.70	7.82	9.93	199	<5	<0.005	8
-4M				2.5	13.69	9.83	7.82	9.93	285			
-4B				5.0	13.72	10.02	7.82	9.96	324			
C2-1S	1320	61° 13.956’	149° 59.093’	0.5	13.86	11.09	7.67	9.25	72 / 73	<5	<0.005	7
-1M				11.5	13.90	11.20	7.87	9.35	133			
-1B				22.5	13.73	11.79	7.84	9.30	110			
C2-S(A)	1335	61° 14.282’	149° 57.610’	0.5	13.87	11.14	7.80	9.28	93	<5	<0.005	2
-2S(B)	1335			0.5	13.90	11.14	7.81	9.47	88	<5	<0.005	4
-2S(C)	1335			0.5	13.87	11.16	7.81	9.22	110	<5	<0.005	7
-2M				4.0	13.79	11.38	7.81	9.25	73			
-2B				8.0	13.71	11.69	7.80	9.27	336			

Table 17. Hydrographic and Water Quality Data, 24 and 25 June 2003. (continued)

Station Number	Time (ADT)	Latitude (North)	Longitude (West)	Depth (M)	Temp[b] (˚C)	Salinity[b] (‰)	pH[b] (units)	D.O.[b] (mg/L)	Turbidity (NTU)	Color (units)	TRC (mg/L)	Fecal Coliform[a]
C2-3S	1400	61° 14.838’	149° 55.403’	0.5	14.08	11.05	7.73	9.31	53	<5	<0.005	4
-3M				15.0	13.73	11.78	7.82	9.22	240			
-3B				29.5	13.72	11.53	7.82	9.35	309			
C2-4S	1430	61° 15.546’	149° 53.721’	0.5	14.07	10.96	7.83	9.90	64	<5 / <5	<0.005	4
-4M				17.0	14.13	11.42	7.84	9.54	170			
-4B				33.5	13.76	11.19	7.84	9.54	269			
C3-S(A)	1522	61° 13.941’	149° 59.100’	0.5	13.76	12.49	7.80	9.25	179	<5	<0.005	11
-1S(B)	1522			---	---	---	---	---	188	<5		4
-1S(C)	1522			---	---	---	---	---	173	<5		11
-1M				10.0	13.74	12.50	7.82	9.25	229 / 243			
-1B				19.5	13.73	12.54	7.81	9.25	281			
C3-2S	1540	61° 14.290’	149° 57.193’	0.5	13.87	12.30	7.81	9.75	231	<5	<0.005/<0.005	4
-2M				5.5	13.77	12.52	7.83	9.86	311			
-2B				11.0	13.74	12.64	7.82	10.02	456			
C3-3S	1600	61° 14.675’	149° 55.851’	0.5	13.88	12.29	7.78	9.27	178	<5	<0.005	11
-3M				12.5	13.78	12.56	7.84	9.24	368			
-3B				24.5	13.74	12.66	7.82	9.29	394			
C3-4S	1625	61° 14.994’	149° 54.541’	0.5	13.96	11.92	7.81	9.27	192	<5	<0.005	8
-4M				25.0	13.82	12.40	7.91	9.27	193			
-4B				50.0	13.71	12.82	7.87	9.38	375 / 364			

Table 17. Hydrographic and Water Quality Data, 24 and 25 June 2003. (continued)

Station Number	Time (ADT)	Latitude (North)	Longitude (West)	Depth (M)	Temp[b] (˚C)	Salinity[b] (‰)	pH[b] (units)	D.O.[b] (mg/L)	Turbidity (NTU)	Color (units)	TRC (mg/L)	Fecal Coliform[a]
JUNE 25												
E1-1S	0522	61° 12.339’	150 ° 01.295’	0.5	13.56	12.95	7.81	9.27	95	10	<0.005	130
-1M				4.5	13.58	13.37	7.82	9.29	154			
-1B				9.0	13.50	13.94	7.84	9.31	236			
E1-2S	0534	61° 12.318’	150° 02.002’	0.5	13.56	13.32	7.84	9.27	94	5	0.001 J	50
-2M				7.0	13.49	13.81	7.88	9.31	175 / 186			
-2B				14.0	13.28	15.13	7.86	9.40	187			
E1-3S	0545	61° 12.244’	150° 02.614’	0.5	13.54	13.41	7.85	9.22	78	5	0.004 J	300
-3M				7.0	13.39	14.39	7.89	9.28	113			
-3B				14.0	13.27	15.33	7.87	9.31	141			
E1-4S	0605	61° 12.036’	150° 04.054’	0.5	13.47	13.68	7.84	9.26	73 / 79	10	<0.005	500
-4M				8.0	13.24	15.30	7.82	9.35	75			
-4B				16.5	13.26	15.41	7.82	9.40	104			
E2-1S	0647	61° 12.341’	150° 01.294’	0.5	13.60	13.31	7.84	9.55	153	15	<0.005	17
-1M				5.0	13.60	13.40	7.85	9.64	159			
-1B				10.0	13.59	13.50	7.85	9.71	244			

Table 17. Hydrographic and Water Quality Data, 24 and 25 June 2003. (continued)

Station Number	Time (ADT)	Latitude (North)	Longitude (West)	Depth (M)	Temp[b] (˚C)	Salinity[b] (‰)	pH[b] (units)	D.O. (mg/L)	Turbidity (NTU)	Color (units)	TRC (mg/L)	Fecal Coliform[a]
E2-2S(A)	0652	61° 12.259	150° 01.995’	0.5	13.60	13.36	7.84	9.32	208	15	<0.005	80
-2S(B)				0.5	13.60	13.45	7.84	9.18	NA			
-2M				5.0	13.60	13.37	7.85	9.38	208			
-2B				10.0	13.60	13.42	7.84	9.42	218			
E2-3S	0701	61° 11.998’	150° 02.780’	0.5	13.59	13.45	7.85	9.18	220	10	<0.005	80
-3M				2.0	13.58	13.46	7.83	9.15	224 / 236			
-3B				3.5	13.58	13.46	7.80	9.16	223			
E2-4S	0729	61° 11.435’	150° 04.152’	0.5	NA	NA	NA	NA	175	15	<0.005	22
-4M				3.5	NA	NA	NA	NA	184			
-4B				6.5	NA	NA	NA	NA	210			
E3-1S	0838	61° 12.343’	150° 01.284’	0.5	13.70	12.30	7.84	9.93	296	15	<0.005	30
-1M				2.5	13.70	12.29	7.84	9.99	291			
-1B				5.0	13.71	12.28	7.82	10.06	308			
E3-2S	0846	61° 12.303’	150° 02.075’	0.5	13.70	12.23	7.83	9.54	328	10	<0.005/<0.005	80
-2M				4.5	13.70	12.23	7.84	9.60	325			
-2B				9.0	13.70	12.24	7.84	9.67	342 / 311			
E3-3S	0855	61° 12.200’	150° 02.608’	0.5	13.70	12.21	7.84	9.54	296	10 / 10	<0.005	23
-3M				5.0	13.70	12.21	7.85	9.62	293			
-3B				9.5	13.70	12.21	7.83	9.68	291			

Table 17. Hydrographic and Water Quality Data, 24 and 25 June 2003. (continued)

Station Number	Time (ADT)	Latitude (North)	Longitude (West)	Depth (M)	Temp[b] (˚C)	Salinity[b] (‰)	pH[b] (units)	D.O. (mg/L)	Turbidity (NTU)	Color (units)	TRC (mg/L)	Fecal Coliform[a]
E3-4S	0921	61° 11.811’	150° 03.913’	0.5	13.70	12.15	7.85	10.49	294	5 / 5	<0.005	17
-4M				3.5	13.70	12.15	7.84	10.65	324			
-4B				6.5	13.70	12.16	7.84	10.78	326			
F1-1S	1206	61° 12.355’	150° 01.277’	0.5	13.75	12.25	7.78	10.22	69	15	0.006	900
-1M				1.0	13.75	12.29	7.77	10.22	81			
-1B				2.0	13.73	12.44	7.80	10.24	90			
F1-2S	1235	61° 12.471’	150° 00.610’	0.5	13.80	11.60	7.81	9.97	68 / 75	5	0.003 J	500
-2M				1.5	13.80	11.65	7.79	10.02	78			
-2B				3.0	13.79	11.68	7.80	10.06	104			
F1-3S	1250	61° 12.366’	149° 59.783’	0.5	13.80	11.67	7.82	9.81	82	5	0.001 J/<0.005	30
-3M				2.0	13.80	11.71	7.81	9.81	96			
-3B				4.0	13.80	11.75	7.81	9.83	114			
F1-4S	1316	61° 12.331’	149° 58.710’	0.5	13.83	11.40	7.83	10.20	106	5	<0.005	4
-4M				2.0	13.82	11.40	7.83	10.28	137			
-4B				4.0	13.82	11.40	7.83	10.36	156			
F2-1S	1355	61° 12.341’	150° 01.276’	0.5	13.70	13.07	7.81	11.58	250	10	0.003 J	80
-1M				2.5	13.68	13.16	7.83	11.86	269 / 278			
-1B				4.5	13.68	13.12	7.82	12.08	275			
F2-2S	1406	61° 12.544’	150° 00.677’	0.5	13.69	13.11	7.84	9.86	271	10	<0.005	300
-2M				4.5	13.69	13.10	7.84	9.92	283			
-2B				8.5	13.69	13.07	7.84	10.03	326			

Table 17. Hydrographic and Water Quality Data, 24 and 25 June 2003. (continued)

Station Number	Time (ADT)	Latitude (North)	Longitude (West)	Depth (M)	Temp[b] (˚C)	Salinity[b] (‰)	pH[b] (units)	D.O. [b] (mg/L)	Turbidity (NTU)	Color (units)	TRC (mg/L)	Fecal Coliform[a]
F2-3S	1415	61° 12.661’	150° 00.059’	0.5	13.71	12.90	7.84	9.82	160	5	<0.005	80
-3M				7.0	13.69	12.85	7.87	9.94	304			
-3B				14.0	13.70	12.82	7.88	10.10	384			
F2-4S	1434	61° 12.613’	149° 59.272’	0.5	13.73	12.94	7.85	10.31	178	10	<0.005	50
-4M				4.0	13.70	12.87	7.85	10.46	286			
-4B				7.5	13.70	12.85	7.84	10.66	378 / 362			
F3-1S	1607	61° 12.344’	150° 01.275’	0.5	13.59	12.82	7.85	NA	248	5	<0.005	23
-1M				6.0	13.56	12.98	7.98	NA	272			
-1B				11.5	13.55	13.00	8.00	NA	275			
F3-2S	1615	61° 12.610’	150° 00.807’	0.5	13.60	12.77	7.84	NA	242	5	<0.005	21
-2M				9.0	13.55	13.09	7.87	NA	256			
-2B				17.5	13.54	13.24	7.86	NA	270			
F3-3S	1625	61° 12.838’	150° 00.276’	0.5	13.60	12.83	7.84	10.13	214	5	<0.005	30
-3M				8.0	13.55	13.35	7.85	10.32	285			
-3B				15.5	13.55	13.46	7.84	10.63	310			
F3-4S	1642	61° 13.271’	149° 59.355’	0.5	13.64	13.09	7.84	9.49	152	15 / 15	<0.005	23
-4M				17.5	13.59	13.26	7.85	9.55	296 / 287			
-4B				35.0	13.52	13.63	7.85	9.67	306			

[a] Fecal coliform reported as MPN/100 mL.
[b] Values from CTD for 0.5 m depth taken as close to surface as possible.
NA Not available; CTD malfunction.
--- Samples not collected.
J Estimated value.

reaching 650 m distance from the diffuser, the ZID-boundary station was sampled. The third and fourth stations were then sampled along the drogue's path. Due to high current speeds, anchoring the vessel and sampling at each station was not practical or desirable for this type of sampling.

Table 17 provides a summary of the water quality measurements obtained, where the station designation is represented by: drogue drop location (C=control, E=ebb, and F=flood), the first number represents the drogue number, and the second number represents the station along the drogue's path. The final character represents surface (S), mid-depth (M), or bottom (B) sample. Values for pH ranged from 7.67 to 8.0 with no vertical stratification. Turbidity values for water samples collected during the monitoring ranged from a low of 34 Nephelometric Turbidity Units (NTU) to a high of 456 NTU.

Representative hydrographic profiles of water quality are presented for the second station on the second flood drogue, Station F2-2, and the second station on the third control drogue drop, Station C3-2 (Figure 10). The water column was found to be generally well-mixed from the surface to the bottom at all stations. Refer to Appendix D6 for hydrographic profile plots from each water quality station.

Surface samples were obtained at each station for the analysis of color, TRC, and fecal coliform bacteria. Color values ranged from <5 to 15 color units on the platinum-cobalt scale. Most TRC concentrations were at or below the detection limit of 0.005 mg/L, including some lower values that were reported and qualified with the code "J" as being below the detection limit (e.g., 0.003 J mg/L). TRC was detected above the detection limit at 0.006 mg/L at only one station (F1-1), taken just after low slack water. It should be noted that the method detection limit achievable for TRC analysis is higher than the State-specified limit of 0.002 mg/L (for salmonid fish). The amperometric method that was used is the preferred method since it is affected little by common oxidizing agents, temperature, turbidity, or color, but all TRC methods are subject to positive interferences in estuarine or marine waters. The average TRC concentrations of the effluent (collected every three hours for a total of eight samples per 24-hour period) as reported in the Monthly Monitoring Report for the sampling dates 24 and 25 June 2003 were 0.11 and 0.13 mg/L, respectively. The effluent TRC grab obtained approximately one hour prior to performing the effluent grab sampling was 0.7 mg/L; while that taken two hours after the sampling was 0.19 mg/L.

Fecal coliform values this year ranged from <2 to 900 FC MPN/100 mL. The highest fecal coliform concentration was seen at the within-ZID Station F1-1, taken just after low slack water. Stations F1-2 and F2-2 exhibited fecal concentrations of 500 and 300 FC MPN/100 mL, respectively. Control stations ranged from 2 to 11 FC MPN/100 mL with a median of 4 FC MPN/100 mL. Outfall values during the ebb tide ranged from 17 to 500 FC MPN/100 mL, with all but three stations (E1-1, E1-3, E1-4) falling within the 17 to 80 FC MPN/100 mL range. Outfall values during the flood tide ranged from 4 to 900 FC MPN/100 mL, with all but Stations F1-1, F1-2, and F2-2 falling within the 4 to 80 FC MPN/100 mL range. The overall median for all outfall stations (both ebb and flood) fecal coliform samples was 50 FC MPN/100 mL. See Sections 3.2.2 and 5.2.2 below for more discussion of fecal coliform.

In addition to routine monitoring conducted at each water quality station, supplemental surface samples were collected from the first three stations along the first drogue trajectory for the ZID

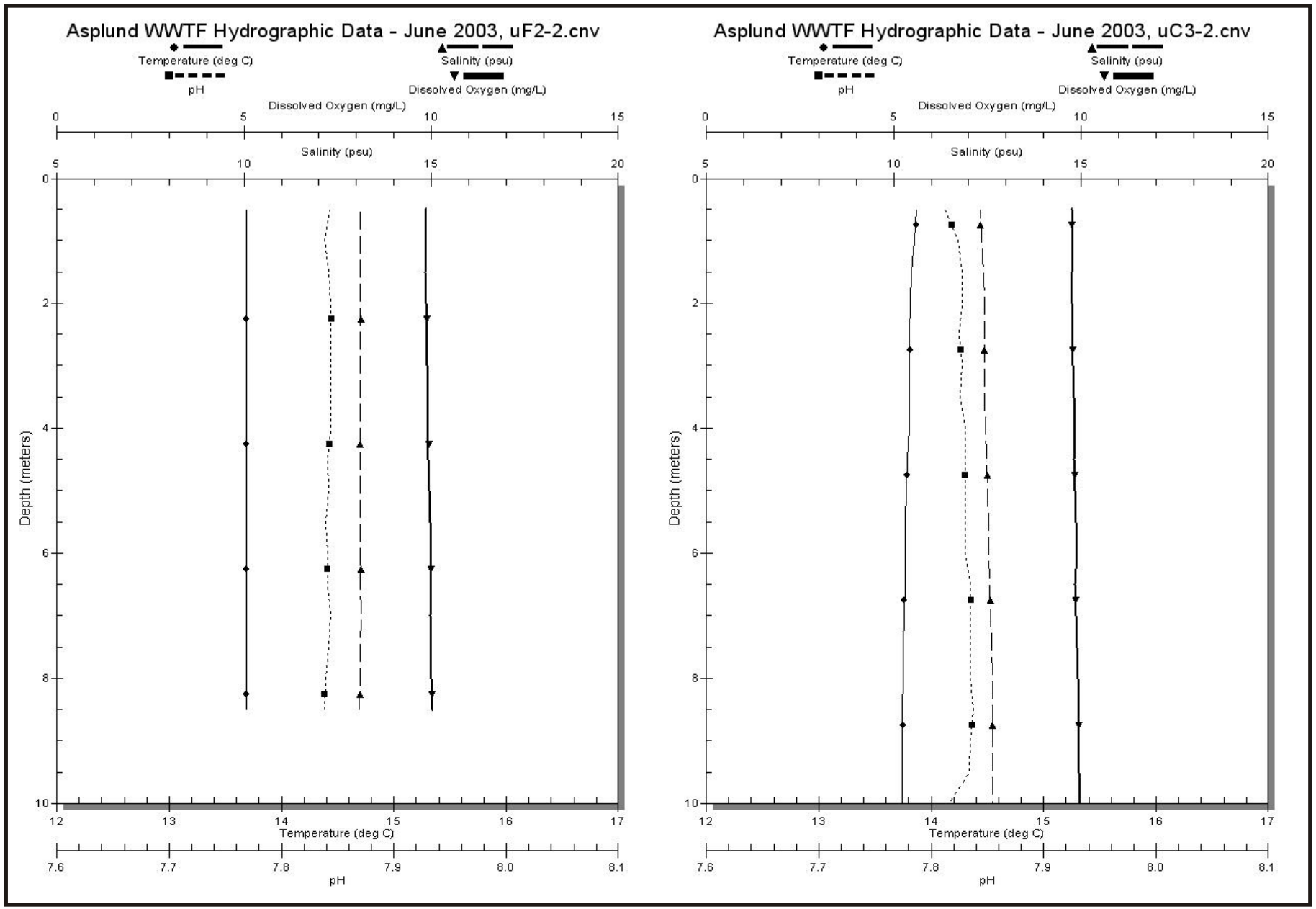


Figure 10. Sample Hydrographic Profiles from Outfall and Control Stations, June 2003.

and control floods. A sample of final effluent was also obtained at the same time for comparison. Supplemental samples were analyzed for polycyclic aromatic hydrocarbons (PAHs); dissolved and total recoverable trace metals; cyanide; and TSS.

Metals, cyanide, and TSS results for these samples are presented in Table 18. Dissolved metals concentrations were generally found to be low, but were quite variable between stations. For all dissolved metals except silver, the highest concentrations were seen at Station F1-1 which was located at low slack water above the diffuser, within the ZID. The maximum dissolved silver concentration was seen at control Station C1-2. Dissolved chromium was nearly as high in concentration at the control Station C1-3 (0.225 µg/L) as that at the within-ZID Station F1-1 (0.229 µg/L). Dissolved silver was slightly higher at Station C1-2 (0.523 µg/L) than at Station F1-3, the latter of which showed the highest concentration of the outfall stations. All dissolved metals concentrations met water quality criteria as they were considerably less than the State of Alaska SSWQC for the Point Woronzof area. Dissolved copper was reported at 5.16 µg/L at Station F1-1, which was in excess of the SSWQC of 3.1 µg/L, but this criterion does not apply to this station as it was located within the ZID. Dissolved copper values at the ZID-boundary Station (F1-2) and the near-field station (F1-3) met the SSWQC. Differences between dissolved concentrations at the outfall stations compared to control were most striking for copper, mercury, lead, silver, and zinc, with outfall stations higher in concentration than the control stations. Cyanide results from the ambient water stations were all below the detection limit of 1 µg/L except for the within-ZID Station F1-1, which was reported at 2.0 µg/L. The AWQS for this parameter is 1 µg/L. Cyanide concentrations in the effluent sample collected in conjunction with the receiving water sampling were 2.1 and 1.82 µg/L for the sample and laboratory duplicate, respectively. Total suspended solid results ranged from 40 to 344 mg/L at the control stations and from 68 to 170 mg/L at the outfall stations, and was 64 mg/L in the effluent sample.

Total metals concentrations were quite variable, and with the exception of silver (Ag), differences between the outfall and control sites did not appear to exist that could be attributed to the discharge but were the result of differences in TSS concentrations. Control Station C1-3 was found to have the highest concentrations for chromium, mercury, nickel, lead, and zinc tested by total recoverable methodology. These relatively high concentrations can be attributed to high suspended sediment load at this station as evidenced by the 344 mg/L of TSS. Total arsenic, cadmium, copper, and silver were highest at Station F1-1. Total silver was highest at Station F1-1 (0.952 µg/L), but this metal was seen at the much lower concentrations at Stations F1-2 (0.136 µg/L) and Station C1-3 (0.125 µg/L), with all other stations falling below these levels. For the outfall stations, Stations F1-1 and F1-2 had higher concentrations for all the total recoverable metals tested than Station F1-3. TSS concentrations, however, were highest at Station F1-1, followed by Station F1-3 rather than Station F1-2.

Hydrocarbon analyses results are presented in Table 19. Total aromatic hydrocarbons as BETX (EPA Method 602 samples from the concurrent summer dry sampling) was determined by summing benzene, ethylbenzene, toluene, and total xylenes. For values reported as ND, the reporting limit was used in the summation. Total aromatic hydrocarbons at the water quality stations were below the reporting limit of 0.5 µg/L at all control stations as well as outfall Stations F1-1 and F1-3, well below the receiving water standard of 10 µg/L. At Station F1-2, located at the ZID-boundary, total aromatic hydrocarbons as BTEX was calculated to be 30.2 µg/L for both the samples collected, in excess of the water quality standard. The effluent sample had concentrations of 15.5 µg/L with a duplicate value of 16.8 µg/L, significantly less than the MAEC of 1,810 µg/L.

Table 18. Concentrations of Dissolved Metals, Total Recoverable Metals, Cyanide, and Total Suspended Solids in Receiving Water and Effluent Samples. Values have not been blank corrected.

Station	Arsenic	Cadmium	Cyanide	Chromium	Copper	Mercury	Nickel	Lead	Silver	Zinc	TSS
	µg/L					ng/L	µg/L				mg/L
Dissolved Metals											
F1-1S (WITHIN ZID)	1.83	0.0865	NA	0.229	5.16	0.879	0.864	0.0503B	0.0181	8.05	NA
F1-2S (ZID BOUNDARY)	1.80	0.0742	NA	0.192	1.64	0.890	0.747	0.0282B	0.0174	1.60	NA
F1-3S (NEAR FIELD)	1.63	0.0738	NA	0.211	1.20	1.04	0.677	0.0301B	0.0521	3.30	NA
C1-1S (CONTROL)	1.59	0.0663	NA	0.183	1.04	0.658	0.679	0.0296B	0.0236	1.36	NA
C1-2S (CONTROL)	1.61	0.0597	NA	0.209	0.949	0.529	0.673	0.0238B	0.0523	0.500 U	NA
C1-3S (CONTROL)	1.55	0.0627	NA	0.225	0.987	0.766	0.726	0.0243B	0.0189	0.811	NA
EFFLUENT	1.61	0.128	NA	0.554	25.4	4.54	2.03	0.395B	0.208	22.9	NA
DETECTION LIMIT	0.028	0.017	NA	0.066	0.040	0.10	0.029	0.004	0.013	0.500	NA
Total Metals											
F1-1S (WITHIN ZID)	6.77	0.164	2.0	12.3	24.7	33.4	12.4	4.20B	0.952	47.0	170
F1-2S (ZID BOUNDARY)	6.73	0.115	ND	12.0	16.0	20.1	12.1	3.69B	0.136	33.4	68
F1-3S (NEAR FIELD)[a]	6.49/6.53	0.102/0.0991	ND	10.7/10.9	13.7/14.0	19.4	10.7/11.0	3.45B/3.58B	0.0933/0.0967	29.2/29.7	164
C1-1S (CONTROL)	3.55	0.0855	ND	4.71	6.08	7.78/7.33	4.90	1.61B	0.0604	12.5	46
C1-2S (CONTROL)[b]	3.33	0.0771	ND/ND	4.47	5.77	7.12	4.67	1.26B	0.0594	11.0	40/46
C1-3S (CONTROL)	1.89	0.129	ND	18.2	23.3	37.8	18.5	6.13B	0.125	47.5	344
EFFLUENT	10.4	0.320	2.1/1.82[a]	2.45	50.9	79.5	2.12	3.52B	3.79	51.3	64
DETECTION LIMIT	0.028	0.017	1.0c	0.066	0.040	0.10	0.029	0.004	0.013	0.500	1.0[c]

[a] Field sample value/lab duplicate value (where applicable)
[b] Field sample value/field blank value (where applicable)
[c] Reporting limit
B Blank contamination may have affected sample concentration
NA Not applicable
ND None detected

Table 19. Supplemental Receiving Water and Effluent Hydrocarbon Analyses.

PARAMETER	CONTROL FLOOD SAMPLES			ZID FLOOD SAMPLES			EFFLUENT
	C1-1S	C1-2S	C1-3S	F1-1S	F1-2S[a]	F1-3S	
Volatile Organics (EPA 602) in µg/L with reporting limit in parenthesis if ND							
Benzene	ND(0.5)	ND(0.5)	ND(0.5)	ND(1.0)	ND(1.0)/ND(1.0)	ND(0.5)	ND(1.0)/ND(1.0)
Toluene	ND(0.5)	ND(0.5)	ND(0.5)	ND(1.0)	15 / 15	ND(0.5)	5.8/6.4
Ethylbenzene	ND(0.5)	ND(0.5)	ND(0.5)	ND(1.0)	2.2 / 2.2	ND(0.5)	1.8/1.1
Xylenes	ND(0.5)	ND(0.5)	ND(0.5)	ND(1.0)	12 / 12	ND(0.5)	6.9/8.3
Total Aromatics (as BETX)	ND	ND	ND	ND	30.2/30.2	ND	15.5/16.8
Polyaromatic Aromatic Hydrocarbons (PAH) by GC/MS in µg/L							
TPAH without perylene	0.098	0.114	0.129	1.154	0.339	0.156	8.794
Total Aqueous Hydrocarbons (TAqH) in µg/L							
TAqH[b]	2.098	2.114	2.129	5.154	30.54/30.54	2.156	24.29/25.59

a Duplicate field sample analysis provided (value/duplicate value)
b Defined by the State of Alaska as BETX analyte values from EPA Method 602 plus PAH analyte values from EPA Method 610 analysis, these calculated values include the full suite of PAH analyte values from GERG SOP 8901/9733 not analyte values from EPA method 610
ND None detected

All concentrations of individual PAHs were summed and reported as total PAHs (TPAH) in Table 19. The TPAH values ranged from 0.10 to 0.11 µg/L at the control stations and from 0.16 to 1.15 µg/L at the outfall stations. The highest TPAH was seen at Station F1-1. The TPAH concentration in the effluent was 8.79 µg/L.

Total aqueous hydrocarbons (TAqH) as determined by PAHs plus BETX were calculated for the six stations and effluent, with the contribution from BETX assumed to be 2 µg/L (the sum of the individual detection limits for each compound; Table 19). Concentrations of TAqH were below the receiving water standard of 15 µg/L at all control stations (2.098 – 2.129 µg/L) as well as outfall Stations F1-1 and F1-3 (5.154 and 2.156 µg/L, respectively. Concentrations of TAqH at Station F1-2 were 30.54 µg/L for the two samples collected, exceeding the receiving water quality criterion of 15 µg/L. The concentration of TAqH in the effluent was 24.29 µg/L with a duplicate value of 25.59 compared to the MAEC of 2 ,715 µg/L.

3.2.2 Intertidal Zone and Stream Bacterial Sampling

Intertidal zone and stream bacteriological sampling was performed on 25 June 2003. Intertidal zone sampling began approximately 1 hour prior to high tide at 17:07 ADT and was completed at

18:00 ADT. Two replicates were taken at all intertidal stations. Stream sampling was conducted from 12:55 to 13:31 ADT on 25 June 2003. In addition, an effluent sample was collected at the plant at 11:45 ADT on this date. A summary of the sampling results is presented in Table 20. Refer to Figure 3 for a map of the station locations.

Fecal coliform concentrations in the intertidal were quite low this year and ranged from <2.0 to 30 FC MPN/100 mL. The highest fecal concentrations seen were at Station IT-5 (23 and 30 FC MPN/100 mL for the two replicates), Station IT-1 (17 and 11 FC MPN/100 mL), and Station IT-3 (22 and 11 FC MPN/100 mL). The control station IT-C4, located across the inlet near Point MacKenzie, had concentrations of 8 FC MPN/100 mL for both replicates sampled. Fecal coliform concentrations found in the streams were lower than those seen in many past years and ranged from 4 FC MPN/100 mL in one replicate at Chester Creek to 70 FC MPN/100 mL for both replicates collected at Fish Creek. The plant effluent sample taken on the same day was analyzed in duplicate and showed fecal concentrations of 130 and 240 FC MPN/100 mL.

3.3 SEDIMENT AND BIOACCUMULATION MONITORING RESULTS

A sediment quality and bioaccumulation program was to be conducted in the summer during the fourth year after the effective date of the permit. The sediment quality program included sampling at three intertidal and two subtidal locations during 2003. The bioaccumulation component of the program, however, could not be performed during 2003 due to insufficient intertidal algae growth as described below.

3.3.1 Intertidal Sediment Monitoring

Sediment samples were collected for chemistry analyses from the three intertidal stations on 24 – 25 June 2003. Samples were analyzed for sediment grain size distribution, total volatile solids, and toxic pollutants and pesticides (Table 21). Silt and clay were the predominant sediment fraction at all stations ranging from a station mean of 95.1 % at Station IT-2 to 97.9 % at Station IT-C. Percent TVS were also very similar between locations ranging from 3.0 % at Station IT-C to 3.5 % at Station IT-1. No semi-volatile compounds, pesticides, dioxins, or asbestos were found in any of the nine samples that were analyzed. A number of volatile compounds at low concentrations were found in one replicate from Station IT-1. These compounds included ethylbenzene, toluene, and xylenes that are normally associated with gasoline and some other petroleum products and methylene chloride which is a common laboratory solvent and contaminant. Other analyses that were performed included 13 priority pollutant metals and cyanide. Cyanide was detected near the detection limit in the second replicate from Station IT-C. Concentrations of metals were very similar between stations and were very typical for marine sediment concentrations with no sign of elevated concentrations. Many of the metals appeared to be slightly lower at the control site versus the two locations nearer to the outfall, which is probably a function of the lower TVS and associated total organic carbon content. Due to the breakage of the Station IT-1, Replicate 2 sample bottle in transit, some analyses were performed on excess sediment from another sample outside of the holding time; no TVS analysis was performed on this replicate due to lack of sample material (see Table 21).

3.3.2 Subtidal Sediment Monitoring

Due to the coarse cobble substrate at the subtidal stations, chemistry samples could not be obtained with a van Veen grab sampler. Instead, a pipe dredge was utilized to obtain replicate

Table 20. Summary of Bacterial Analyses, 25 June 2003.

Station and Replicate	Sample Time (ADT)	Fecal Coliform MPN/100 mL
IT-1 Replicate 1	18:00	17
IT-1 Replicate 2	18:00	11
IT-2 Replicate 1	17:56	2
IT-2 Replicate 2	17:56	4
IT-3 Replicate 1	17:53	22
IT-3 Replicate 2	17:53	11
IT-4 Replicate 1	17:50	13
IT-4 Replicate 2	17:50	<2
IT-5 Replicate 1	17:47	23
IT-5 Replicate 2	17:47	30
IT-6 Replicate 1	17:45	23
IT-6 Replicate 2	17:45	8
IT-7 Replicate 1	17:40	8
IT-7 Replicate 2	17:40	9
IT-C Replicate 1	17:07	8
IT-C Replicate 2	17:07	8
Plant Effluent Rep. 1	11:45	130
Plant Effluent Rep. 2	11:45	240
Fish Creek Rep. 1	13:15	70
Fish Creek Rep. 2	13:15	70
Chester Creek Rep.1	13:31	4
Chester Creek Rep.2	13:31	13
Ship Creek Rep. 1	12:55	11
Ship Creek Rep. 2	12:55	13

Table 21. Sediment Quality Data, 24 - 25 June 2003.

Pollutant	IT-1 Rep. 1	IT-1 Rep. 2	IT-1 Rep. 3	Mean	Standard Deviation	IT-2 Rep. 1	IT-2 Rep. 2	IT-2 Rep. 3	Mean	Standard Deviation	IT-C Rep. 1	IT-C Rep. 2	IT-C Rep. 3	Mean	Standard Deviation
VOLATILES (EPA Method 8260B) (µg/kg)															
Ethylbenzene	9.4	ND (7.1)	ND (7.5)	8.0	1.23	ND(7.8)	ND(7.6)	ND(7.9)	---	---	ND(7.7)	ND(7.4)	ND (7.5)	---	---
Methylene chloride	2.3 J	ND(14)	ND(15)	10.4	0.71	ND(16)	ND(15)	ND(16)	---	---	ND(15)	ND(15)	ND(15)	---	---
Toluene	41	ND (7.1)	ND (7.5)	18.5	19.46	ND(7.8)	ND(7.6)	ND(7.9)	---	---	ND(7.7)	ND(7.4)	ND (7.5)	---	---
Xylenes (total)	37	ND (7.1)	ND (7.5)	17.2	17.15	ND(7.8)	ND(7.6)	ND(7.9)	---	---	ND(7.7)	ND(7.4)	ND (7.5)	---	---
SEMI-VOLATILES (EPA Method 8270C) (µg/kg)															
All Compounds	ND	ND[a]	ND	---	---	ND	ND	ND	---	---	ND	ND	ND	---	---
TOTAL METALS (EPA 6000/7000 Series) (µg/g)															
Antimony	1.32	0.913[b]	0.829	1.02	0.26	0.859	1.08	0.690	0.88	0.20	0.769	0.797	0.683	0.750	0.06
Arsenic	19.8	12.2[b]	14.9	15.6	3.85	19.2	18.8	15.7	17.9	1.92	13.4	10.9	13.9	12.7	1.61
Beryllium	0.930	0.625[b]	0.648	0.734	0.17	0.814	0.847	0.715	0.792	0.07	0.634	0.442	0.641	0.572	0.11
Cadmium	0.255	0.160[b]	0.191	0.202	0.05	0.208	0.215	0.165	0.196	0.03	0.162	0.157	0.159	0.159	0.00
Chromium	72.6	57.5[b]	52.3	60.8	10.54	62.2	62.8	56.9	60.6	3.25	51.4	37.4	51.2	46.7	8.03
Copper	60.6	38.9[b]	42.6	47.4	11.61	55.2	55.1	45.5	51.9	5.57	38.9	30.1	42.3	37.1	6.30
Lead	14.9	9.03[b]	10.0	11.3	3.15	13.6	13.4	10.8	12.6	1.56	8.66	8.39	9.15	8.73	0.39
Mercury	0.0956	0.0638[b]	0.0723	0.077	0.02	0.0622	0.0558	0.0482	0.0554	0.01	0.0500	0.0542	0.0622	0.0555	0.01
Nickel	58.7	36.3[b]	42.9	46.0	11.51	53.8	52.9	46.0	50.9	4.27	41.9	31.3	41.8	38.3	6.09
Selenium	0.293	ND[b] (0.140)	0.344	0.259	0.11	0.428	0.370	0.355	0.384	0.04	0.285	ND (0.149)	0.336	0.257	0.04
Silver	0.229	0.148[b]	0.156	0.178	0.04	0.183	0.212	ND (0.155)	0.183	0.03	0.151	ND (0.149)	0.154	0.151	0.00

Table 21. Sediment Quality Data, 24 - 25 June 2003. (continued)

Pollutant	IT-1 Rep. 1	IT-1 Rep. 2	IT-1 Rep. 3	Mean	Standard Deviation	IT-2 Rep. 1	IT-2 Rep. 2	IT-2 Rep. 3	Mean	Standard Deviation	IT-C Rep. 1	IT-C Rep. 2	IT-C Rep. 3	Mean	Standard Deviation
Thallium	0.435	0.418[b]	0.279	0.377	0.09	0.366	0.377	0.290	0.344	0.05	0.266	0.263	0.268	0.266	0.00
Zinc	129	90.1[b]	93.7	104.3	21.50	123	121	103	116	11.02	90.1	70.5	93.6	84.73	12.45
PESTICIDES (EPA 8081A, 8141A)															
All Compounds	ND	ND[a]	ND	---	---	ND	ND	ND	---	---	ND	ND	ND	---	---
OTHER COMPONENTS															
Particle Size Distribution (silt+clay) %	98.9	96.3[a]	97.1	97.4	1.33	96.1	94.7	94.6	95.1	0.84	98.2	98.6	96.8	97.9	0.95
Total Volatile Solids (TVS) %	4.0	NT	3.0	3.5	NA	4.1	3.8	3.4	3.8	0.35	2.9	2.4	3.6/3.4	3.0	0.60
Asbestos	ND	ND	ND	---	---	ND	ND/ND	ND	---	---	ND	ND	ND	---	---
Cyanide (µg/g)	ND (0.756)	ND[a] (0.700)	ND (0.748)	---	---	ND (0.827)	ND (0.847)	ND (0.775)	---	---	ND (0.742)	0.780	ND(0.744)/ ND(0.744)	0.755	0.02
Dioxin (2,3,7,8-TCDD) (ng/g)	ND	ND	ND	---	---	ND	ND	ND	---	---	ND	ND	ND	---	---

[a] Original sample broken in transit. Analyzed MOAVOP0040 as a replacement - outside holding time.

[b] Original sample broken in transit. Analyzed MOAVOP0040 as a replacement – within holding time.

NA Not applicable (not calculated)

ND None detected

NT Not tested due to broken sample (see footnote [a]).

J Below MDL or MRL (estimated value)

Field Sample/Lab Duplicate

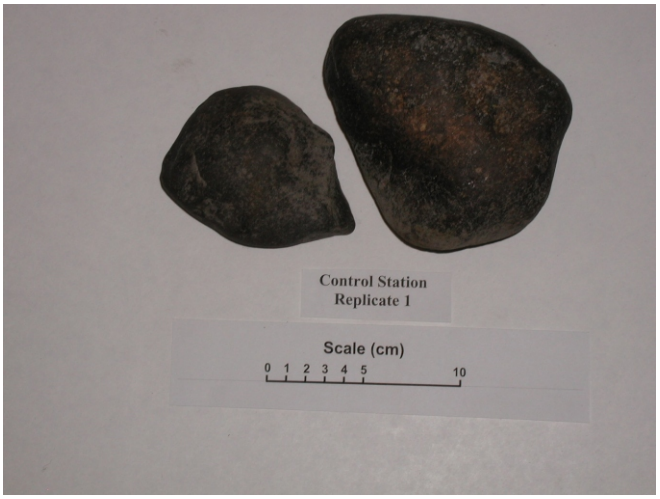
Detection limits or reporting limits are included in parentheses for non-detected (ND) values

samples from each subtidal station on 23 - 26 June 2003. Subtidal samples consisted of three replicate samples from each location. For the outfall site, the dredge was towed down-current (flood) of the diffuser along the ZID boundary. All three replicates from both the outfall and control locations consisted of only cobble, and these samples are depicted in the photographs (Figure 11). No fine-grained sediments were obtained from the subtidal that could be subjected to chemical analyses.

3.3.3 Bioaccumulation Monitoring

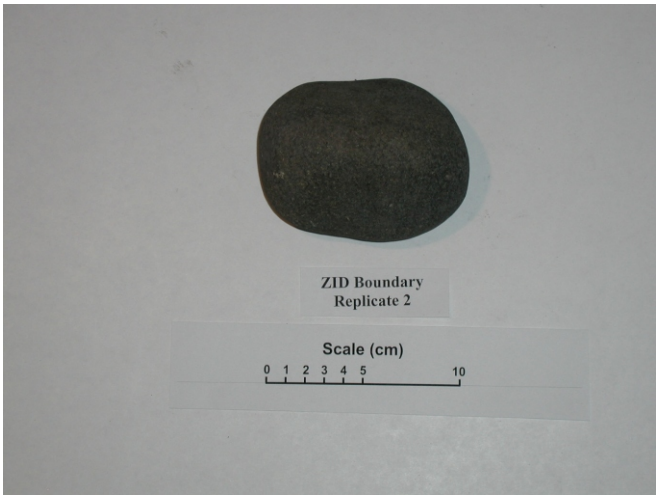
The bioaccumulation program was to include sampling of the yellow-green algae *Vaucheria* spp. from two intertidal locations. However, due to insufficient algae growth during the summer of 2003, the bioaccumulation program could not be performed and was postponed until 2004. This algae is normally associated with brackish water and often is present near high tide level near river mouths or in areas of seepage and runoff of freshwater (Kozloff, 1993). Since the summer of 2003 was relatively dry with low runoff, it is speculated that the Upper Cook Inlet in the vicinity of Anchorage was higher in salinity than normal which inhibited the normal growth of this algae. The mud-flats near the outfall were observed throughout the summer, and the extensive mats of *Vaucheria* spp. that normally grow each summer were never present during 2003. In consultation with AWWU and discussions with EPA, it was decided to postpone the bioaccumulation component of the program until the summer of 2004.

Station ST-1, Rep. 1



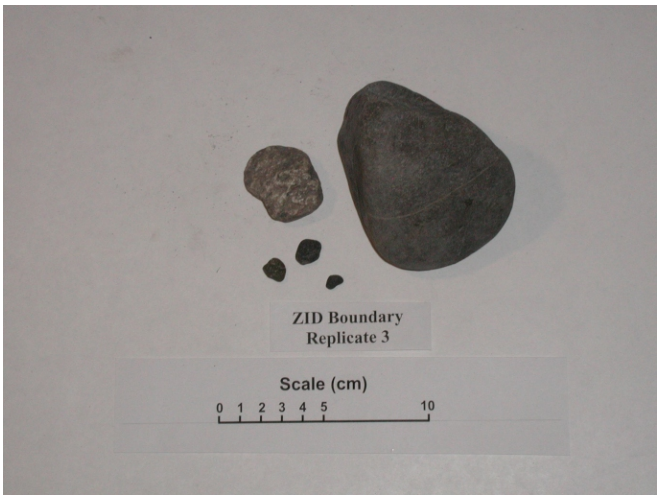
Station ST-C, Rep. 1

Station ST-1, Rep. 2



Station ST-C, Rep. 2

Station ST-1, Rep. 3



Station ST-C, Rep. 3

Figure 11. Subtidal Sediment Particle Size Distribution Photographs, June 2003.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

4.1 OBJECTIVES

The program includes a comprehensive quality assurance/quality control (QA/QC) program that encompasses all aspects of the project, from initial sample collection and field observation recording through laboratory analysis and data analysis to reporting. The objectives of the QA/QC program were to fully document the field and laboratory data collected, to maintain and document data quality, and to ensure that the data collected are of sufficient quality to be comparable with data collected through other EPA-regulated NPDES programs. The program was designed to allow the data to be assessed by the following parameters:

- Precision
- Accuracy
- Comparability
- Representativeness
- Completeness.

These parameters were controlled by adhering to documented methods and procedures, by the analysis of quality control (QC) samples on a routine basis, through the use of laboratories with existing QA/QC plans, through data review and verification procedures, and through a comprehensive sample documentation program. Throughout the program, KLI coordinated with the subcontracting laboratories to ensure that their in-house QA/QC programs were being implemented to meet the required standards.

Quality control activities in the field included adherence to documented procedures, including those in this study plan, and the comprehensive documentation of sample collection and sample identification information. Sample integrity and identification were ensured by a rigidly-enforced chain of custody program. The chain of custody procedure documents the handling of each sample from the time the sample was collected to the arrival of the sample at the laboratory.

Analytical methods in use on the program have been approved and documented by EPA. These methods were used as project-specific protocols to document and guide analytical procedures. Adherence to these documented procedures ensures that analytical results are properly obtained and reported.

4.2 FIELD QUALITY CONTROL

Quality control activities in the field consisted of the following:

- adherence to documented procedures in the workplan
- cross-checking of field identifications, measurements, and recording to ensure consistency and accuracy
- comprehensive documentation of field observations, sample collection, and sample identification information.

Sampling procedures proposed for this project have been successfully used for a number of years on the Asplund WPCF monitoring program. The use of documented and well-known procedures provides for greater likelihood of obtaining environmental samples uncontaminated by sampling procedures or apparatus. The use of project-specific field forms and data entry sheets also provide guidance for sampling procedures. Adherence to these procedures and use of these project documents helped ensure that data collected over the course of the project were comparable and accurate and that the study results are representative of conditions existing at the sampling sites.

4.2.1 Documentation

For observations made in the field, cross-checking between personnel were used as the primary method of quality control. These included, for example, review of navigational information recorded on the drogue field log. As described in the Methods section, sample documentation began in the field using pre-printed logs, labels, COC forms, and pre-determined sample identification numbers that were designed specifically for use on this project. This extensive field documentation provided a paper trail that exists for each sample or field observation and ensures credibility of the data. All field records were reviewed by the field crew leader as soon as possible after sampling was completed. Completed field logs were filed at the KLI Anchorage office upon return of the survey.

Sample integrity and identification were ensured by the COC program. The chain of custody procedure documented the handling of a sample from the time the sample was collected to the arrival of the sample at the laboratory. At the time of shipment, the field personnel kept a copy of the completed chain of custody form, and the original accompanied the samples to the laboratory.

4.2.2 Sample Handling

Samples were frozen, chilled, and/or preserved as required by the appropriate methods in the field and until receipt at the laboratory. Samples were packed in coolers along with the completed COC forms for shipment to analytical facilities as described in the Section 2.0. Coolers were securely packed with ice packs as required and sealed with signed and dated fiber tape for shipment.

4.2.3 Navigation

As described above, navigation was accomplished with a DGPS system. The accuracy of the DGPS coordinates were verified by positioning the vessel over the diffuser during a low slack tide when the boil was evident and comparing DGPS readings with the known outfall location. Intertidal stations were re-occupied using a hand-held GPS, distance and bearings, and visual sitings to temporary benchmarks and landmarks. All station information was entered on the appropriate field logs and reviewed by the field leader.

4.2.4 Field Instrumentation

Field equipment used for collection, measurement, and testing were subject to a strict program of control, calibration, adjustment, and maintenance. Care was taken to ensure that the instruments used for field measurements of temperature, salinity, DO, and pH were calibrated and adjusted

with appropriate standards prior to and after each sampling. The standards of calibration are in accordance with applicable criteria such as the U.S. Bureau of Standards, American Society of Testing and Materials (ASTM) Standards, and follow the instrumentation manufacturer's recommended procedures.

Temperature calibration was ensured by pre-calibration at the factory and field checks of the electronic temperature sensor against a research grade thermometer reading taken from the same sample at the same time. The electronic sensor for salinity (conductivity) was also pre-calibrated at the factory and field checked against six ambient water samples which were collected for the analysis of salinity (SM 2520B) to verify the proper operation of the probe. The DO probe was also pre-calibrated at the factory. For pH, the electronic sensor probe was pre-calibrated using three known buffer solutions.

4.2.5 Sampling Variability

Sampling variability was documented by sampling three replicates at one station for the water quality parameters. This included three replicate Niskin® bottle casts to obtain replicate turbidity samples and three replicate grabs at the surface for fecal coliform, color, and TRC analyses. In addition, triplicate casts of the CTD for pH, DO, temperature, and salinity were performed at one station in order to check reading variability from the probe's electronic sensors.

4.2.6 Field Check Samples

Field check samples include trip blanks for volatile organic analyses for EPA Methods 602 and 624, field blanks, field generated duplicates, and standard reference materials (SRMs), spikes or other samples of known concentration that may be sent to the laboratory. With the exception of the trip blanks which are initiated at the laboratory, most of these samples were sent to the laboratory as blind samples to ensure unbiased reporting of results.

4.3 LABORATORY QUALITY CONTROL

Analytical quality control for this project included the following:

- adherence to documented procedures, particularly EPA methods, internal laboratory protocols, and respective laboratory QA/QC programs
- calibration of analytical instruments
- ability of each analytical laboratory to meet analytical precision, accuracy, limits of detection, and limits of quantification that meet EPA requirements
- use of quality control samples, internal standards, and surrogate solutions

The analytical laboratories used on this project operate under the quality assurance (QA) programs described in their QA management plans. These programs involve the participation of qualified and trained personnel; the use of standard operating procedures for analytical methodology and procedures; a rigorous system of documenting and validating measurements; maintenance and calibration of instruments; and the analysis of quality control samples for precision and accuracy tracking. The pertinent methods descriptions the laboratories are following are comprehensive and provide information concerning proper sample collection, processing, storage, and preservation; required apparatus and materials; analytical procedure;

standardization and calibration techniques; quality control samples required; methods of calculating values and assessing data quality; and reporting and performance criteria.

4.3.1 Documentation

Documentation in the laboratory included finalizing the original COC forms and generating the internal documents that track samples through the laboratory (e.g., sample control logs, refrigerator logs, etc). Any deviations from the prescribed methods or internal laboratory standard operating procedures (SOPs) were documented in the project files. Data affected by such deviations were appropriately qualified, as was any data that did not meet acceptable quality criteria. Typical data qualifiers included those denoting estimated concentrations (J) or not detected (ND or U).

4.3.2 Calibration

Calibration is an integral part of any instrumental analysis. Calibration requirements for each type of analysis to be used on this project are described in the appropriate methods. Typically, instrument calibration was performed daily or on a per batch basis.

4.3.3 Quality Control Procedures

Internal laboratory quality control checks included the use of surrogate solutions and quality control samples such as procedural (or method) blanks, matrix spike/spike duplicates, standard reference materials (SRMs) or EPA QC check samples, and duplicates as specified in the EPA approved analytical procedures. Surrogate compounds were spiked into samples as appropriate to measure individual sample matrix effects that are associated with sample preparation and analysis. This includes QC samples such as procedural blanks and matrix spike samples. Surrogate compound analyses were reported in percent recovery. Results from quality control samples allow the assessment of quality assurance parameters such as accuracy and precision of the data. Any data falling outside the acceptable criteria as defined in the methods were appropriately investigated and qualified.

Method blanks are pure, organic- or metal-free reagent water that are run through the analysis process and used to verify that analyte concentrations are accurate and do not reflect contamination. Method blanks were analyzed as called for by each method, typically one per day or one per sample batch.

Laboratory accuracy was assessed by routine spiking of environmental samples with a standard addition as called for by the appropriate method. Sample spikes and matrix spike/matrix spike duplicates were run on the organic analyses collected as part of both the influent, effluent, and sludge and receiving water monitoring components of the program. These samples are fortified with components of interest following the initial analysis to check the ability of the method to recover acceptable levels and to determine accuracy of the data. Quality control charts are prepared by the laboratories where applicable to show the range of individual measurements encountered by following procedures such as those outlined in Design of 301(h) Monitoring Programs for Municipal Wastewater Discharges to Marine Waters. EPA Document 430/9-82-010.

Trace metals analyses for the monitoring were supported through the use of standard reference materials (SRMs), which are quality control reference materials with known metals values that are obtained from the National Bureau of Standards and other sources. These SRMs were

analyzed by the laboratory at the same time as the program samples in order to ensure laboratory accuracy. Results of the analyses of SRMs should fall within acceptable limits and can be expressed as percent recovery.

Analytical and instrument variability was checked by laboratory splitting of one larger-volume field sample per survey into triplicates and analyzing the subsamples for the various water quality parameters. The individual measurements and concentration ranges were reported for each parameter of each split. In addition, duplicate analyses of samples split in the laboratory were used as a means to assess laboratory precision.

For other water quality parameters, the following summary of QA/QC procedures will apply:

- Fecal Coliform Bacteria: *Escherichia coli* was used as a positive control for each analytical run. *Pseudomonas aeruginosa* was used as a negative control, and buffered dilution water was used as a blank. In addition, 10 % of the samples were run in duplicate.

- Enterococci Bacteria: *Streptococcus faecalis* was used as a positive control for each analytical run. *Escherichia coli* was used as a negative control, and buffered dilution water was used as a blank.

- Color: Fresh color standards were made prior to the beginning of the program. Samples were allowed to settle and were pre-treated with paper filtration to remove turbidity and reported as "true color".

- Turbidity: The instruments was calibrated with a 20.0 standard provided by the manufacturer. Due to the high turbidity in Cook Inlet, all samples were diluted to 10 % prior to analysis to ensure that the measured turbidities were within the range of the instrumentation. In addition, select samples were run in duplicate.

- Total Residual Chlorine: TRC was run by amperometric titration which requires a blank and laboratory control and laboratory control spike samples every ten samples. The amperometric titrant was standardized daily.

- Salinity: A seawater salinity standard was used to check the instrumental accuracy of the salinometer every half-hour or every ten samples whichever is more frequent.

- Dissolved Oxygen Samples: The titrant used was standardized and checked on duplicate reference samples daily. The titrant strength was rechecked during the analyses.

4.3.4 Method Detection Limits

The method detection limits (MDLs) or method reporting limits (MRLs) for the various analytes were determined using the appropriate method as described in the protocols. These MDLs or

MRLs have been reported with the data (see appendices) and included in summary data tables as appropriate. Concentrations below the MDL or MRL were typically qualified with the "ND" code for non-detect.

4.4 DATA REVIEW AND VALIDATION

Data were verified by performing comparisons of final data against the original documentation, including this workplan, field logs and data sheets, and analytical reports. Any discrepancies were fully documented in the program files and reported in the annual report. Data were validated according to accuracy, precision, and completeness for both the field sample collection and analytical laboratory components of the program. Qualitative evaluation and statistical procedures were used to check the quality of the field and chemical data as appropriate. The primary goals of these review and validation procedures are to ensure that the data:

- are representative of conditions in the study area
- are accurate
- demonstrate the required level of precision
- are comparable with data from other NPDES programs
- are acceptable for use as a tool to evaluate permit compliance
- allow independent technical appraisal of the program's ability to meet the monitoring objectives.

Analytical data were subjected to review upon receipt from the laboratory following guidelines such as those published in U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, EPA 540/R-94/013, or U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, EPA 540/R-94/012. Items reviewed during data validation included sample holding times, results for laboratory method blanks, matrix spike/spike duplicates (MS/SD), check standards or SRMs, field and laboratory duplicates, field and trip blanks, report completeness, and laboratory performance (i.e., ability to achieve method detection limits and adherence to QA/QC criteria established for this program). Items failing to meet such validation and review procedures were noted and corrected, if possible. Items that could not be corrected and fell outside of acceptable limits (e.g., a sample analyzed outside holding time) have been noted in this annual report if they occur.

4.5 QUALITY ASSURANCE/QUALITY CONTROL RESULTS

4.5.1 Field Instrumentation and Sampling Quality Control Results

For influent, effluent, and sludge monitoring, field-generated duplicate influent and/or effluent samples were collected for analysis of total aromatic hydrocarbons (EPA 602) and pesticides during the June 2003 sampling. During the August 2003 sampling, duplicate effluent samples were collected for total aromatic hydrocarbons (EPA 602) and metals (total and dissolved antimony, and thallium). Results for these duplicate analyses are provided in Table 11 and Table 12 and the appendices, and were found to be within acceptance limits. Results from duplicate field samples collected for certain parameters during the receiving water sampling such as volatile organics (EPA Method 602), cyanide, and TSS are reported in the appropriate tables (Table 17and Table 18), and were found to be within acceptance limits.

Field blanks were collected for several parameters during each sampling event by pouring HPLC-grade deionized (DI) water into the appropriate sampling containers with the correct preservative. Trip blanks consisted of DI blank samples prepared at the laboratory that went through the same shipping and handling procedures as all the other sample containers of each analytical type; these remained unopened in the field. Field blanks and trip blanks analyzed using EPA Method 602 showed no measurable levels of the target compounds during the June 2003, August 2003, or receiving water monitoring (Appendices A2, B2, and D1). Trip blanks analyzed in conjunction with the EPA 624 analyses for June 2003 and August 2003 showed no detectable levels of the target compounds (Appendices A3 and B3). The field blank analyzed in conjunction with the EPA 624 analyses for both June 2003 and August 2003 showed trace levels of methylene chloride, a common laboratory contaminant. This compound was also detected in the influent and effluent for both sampling events, and values reported for the influent and effluent for this parameter are qualified with the "B" qualifier to indicate this (Table 11 and Table 12).

Sampling variability for water quality parameters (fecal coliform bacteria, color, turbidity, and TRC) was determined by analyzing three surface samples taken at Station C2-2S (Table 22). Where appropriate, the mean, standard deviation, and coefficient of variation are included in Table 22 to provide a measure of variability for the listed parameters. The coefficient of variation for the various sample types was found to be 0 % for color and TRC and 11.89 % for turbidity.

Three replicate fecal coliform samples were also collected at Station C2-2. Mean, standard deviation, and coefficient of variation were not determined for fecal coliform due to nature of the analysis which yields only a most probable number of bacteria per 100 mL. Instead, the ±95 % confidence limits for each sample are provided. Sampling variability for fecal coliform was found to be within the 95 % confidence limits for all three samples.

Variability and calibration checks of the electronics probe were done by performing repeated profiles of temperature, pH, DO, and salinity at one station (C2-2). Results of these calibration checks for the Seabird CTD show that probe variability for temperature, pH, DO, and salinity was extremely low and in all cases with a coefficient of variation of <1.5 % (Table 23). Salinity data obtained from the CTD were compared with salinity grab samples to confirm that the instrument was within calibration. In addition, a precision thermometer was used to verify CTD temperature readings, and the pH sensor was calibrated against three standards prior to field deployment at KLI's laboratory facilities. The salinity, temperature, and pH probes were found to be accurate and within calibration during the survey.

4.5.2 Laboratory Quality Control Results

Full analytical data are provided for each laboratory in the appendices. Laboratory duplicate analyses where performed were found to have a high degree of precision and were within the acceptance criteria for relative percent difference (RPD). Laboratory duplicates were performed for a number of organic analyses and were found to be within acceptance limits.

In addition to the standard laboratory QC procedures, color, fecal coliform, and turbidity, samples collected at Station C3-1 during the receiving water sampling were split in the laboratory and analyzed in triplicate. Mean, standard deviation, and coefficient of variation are reported in Table 22 for these samples (where appropriate). These statistics were not determined

Table 22. Sampling and Laboratory Variability for Water Quality Samples, 24 and 25 June 2003.

Station	Subsample Designation	Fecal Coliform* (MPN/100 mL)	Color (units)	Turbidity (NTU)	TRC (mg/L)
SAMPLING VARIABILITY					
C2-2S	A	2[1-11]	<5	93	<0.005
	B	4[1-15]	<5	88	<0.005
	C	7[2-21]	<5	110	<0.005
Mean	---	---	<5	97	<0.005
Standard Deviation	---	---	0	11.53	0
Coefficient of Variation	---	---	0	11.89	0
LABORATORY VARIABILITY					
C3-1S	A	11[4-29]	<5	179	<0.005
	B	4[1-15]	<5	188	NA
	C	11[4-29]	<5	173	NA
Mean	---	---	<5	180	---
Standard Deviation	---	---	0	7.55	---
Coefficient of Variation	---	---	0	4.19	---
E1-2M	A	NA	NA	175	NA
	B	NA	NA	186	NA
Relative % Difference	---	---	---	6	---
E1-4S	A	NA	NA	73	NA
	B	NA	NA	79	NA
Relative % Difference	---	---	---	8	---
E2-3M	A	NA	NA	224	NA
	B	NA	NA	236	NA
Relative % Difference	---	---	---	5	---
E3-2S	A	NA	NA	NA	<0.005
	B	NA	NA	NA	<0.005
Relative % Difference	---	---	---	---	0
E3-2B	A	NA	NA	342	NA
	B	NA	NA	311	NA
Relative % Difference	---	---	---	10	---
E3-3S	A	NA	10	NA	NA
	B	NA	10	NA	NA
Relative % Difference	---	---	0	---	---
E3-4S	A	NA	5	NA	NA
	B	NA	5	NA	NA
Relative % Difference	---	---	0	---	---
F1-2S	A	NA	NA	68	NA
	B	NA	NA	75	NA
Relative % Difference	---	---	---	10	---
F1-3S	A	NA	NA	NA	0.001 J
	B	NA	NA	NA	<0.005
Relative % Difference	---	---	---	---	---

Table 22. Sampling and Laboratory Variability for Water Quality Samples, 24 and 25 June 2003. (continued)

Station	Subsample Designation	Fecal Coliform* (MPN/100 mL)	Color (units)	Turbidity (NTU)	TRC (mg/L)
F2-1M	A	NA	NA	269	NA
	B	NA	NA	278	NA
Relative % Difference	---	---	---	3	---
F2-4B	A	NA	NA	378	NA
	B	NA	NA	362	NA
Relative % Difference	---	---	---	4	---
F3-4S	A	NA	15	NA	NA
	B	NA	15	NA	NA
Relative % Difference	---	---	0	---	---
F3-4M	A	NA	NA	296	NA
	B	NA	NA	287	NA
Relative % Difference	---	---	---	3	---
C1-1B	A	NA	NA	199	NA
	B	NA	NA	211	NA
Relative % Difference	---	---	---	6	---
C2-1S	A	NA	NA	72	NA
	B	NA	NA	73	NA
Relative % Difference	---	---	---	1	---
C2-4S	A	NA	<5	NA	NA
	B	NA	<5	NA	NA
Relative % Difference	---	---	0	---	---
C3-1M	A	NA	NA	229	NA
	B	NA	NA	243	NA
Relative % Difference	---	---	---	6	---
C3-2S	A	NA	NA	NA	<0.005
	B	NA	NA	NA	<0.005
Relative % Difference	---	---	---	---	0
C3-2M	A	NA	NA	NA	NA
	B	NA	NA	NA	NA
Relative % Difference	---	---	---	---	---
C3-4B	A	NA	NA	375	NA
	B	NA	NA	364	NA
Relative % Difference	---	---	---	3	---

* 95% confidence intervals indicated in brackets (American Public Health Association, 1998. Standard Methods for the Examination of Water and Wastewater. 20th Edition. Washington, D.C. Table 9221.IV.)
NA Not analyzed
--- Not applicable

Table 23. Seabird SEACAT SBE-19 CTD Probe Variability Check, 25 June 2003.

Depth (M)	Temperature (°C)			Salinity (ppt)			pH (units)			DO (mg/l)			Mean (units)				Standard Deviation (units)				Coefficient Of Variation (%)			
C2-	2A	2B	2C	2A	2B	2C	2A	2B	2C	2A	2B	2C	Temp	Sal	pH	DO	Temp	Sal	pH	DO	Temp	Sal	pH	DO
1.0	13.87	13.89	13.84	11.15	11.14	11.17	7.81	7.81	7.82	9.26	9.46	9.21	13.87	11.16	7.81	9.31	0.022	0.016	0.006	0.131	0.16	0.14	0.08	1.40
2.0	13.84	13.86	13.84	11.19	11.16	11.20	7.81	7.81	7.82	9.27	9.46	9.20	13.85	11.18	7.81	9.31	0.009	0.017	0.006	0.137	0.06	0.15	0.08	1.47
3.0	13.81	13.84	13.82	11.28	11.20	11.24	7.81	7.81	7.83	9.26	9.43	9.21	13.82	11.24	7.82	9.30	0.015	0.043	0.010	0.116	0.11	0.38	0.13	1.24
4.0	13.79	13.83	13.78	11.38	11.26	11.35	7.81	7.81	7.83	9.25	9.45	9.22	13.80	11.33	7.82	9.31	0.024	0.063	0.010	0.128	0.17	0.56	0.13	1.37
5.0	13.76	13.78	13.74	11.48	11.43	11.50	7.81	7.81	7.83	9.26	9.44	9.20	13.76	11.47	7.82	9.30	0.019	0.034	0.010	0.127	0.14	0.30	0.13	1.37
6.0	13.74	13.73	13.71	11.57	11.61	11.67	7.81	7.81	7.82	9.26	9.41	9.19	13.73	11.62	7.81	9.29	0.018	0.049	0.007	0.113	0.13	0.42	0.09	1.22
7.0	13.72	13.71	13.70	11.67	11.69	11.70	7.81	7.81	7.82	9.26	9.41	9.19	13.71	11.69	7.81	9.29	0.008	0.014	0.010	0.114	0.06	0.12	0.10	1.22
8.0	13.71	13.71	13.70	11.69	11.68	11.70	7.80	7.81	7.82	9.27	9.41	9.19	13.71	11.69	7.81	9.29	0.006	0.006	0.009	0.114	0.04	0.07	0.11	1.23

for fecal coliform due to nature of the analysis which yields only a most probable number of bacteria per 100 mL. Instead, the ±95 % confidence limits for each sample are provided in Table 22. Coefficient of variation was shown to be approximately 0 for color and 4.2 for turbidity. Fecal coliform values were within the confidence limits. For other analyses where samples were run in duplicate, such as TRC, turbidity, and color samples, the relative percent difference between duplicates was calculated. Laboratory duplicate analyses were found to generally be very low and within acceptable limits. Duplicate results for turbidity ranged from 1 to 10 % RPD. Color and TRC duplicate results showed 0 % difference between duplicates.

Laboratory accuracy was assessed through the use of surrogate recoveries, sample and control spikes and duplicates, and SRMs. Detailed QA/QC results for all contract laboratory analyses are provided in the appendices corresponding to each analysis. Surrogates are compounds that were added to each sample and QC sample that were analyzed by GC methodology, such as volatile organic compounds (EPA 602 and 624/8260), semi-volatile organic compounds (EPA 625/8270), pesticides (EPA 608/8081 and 614/8141A), and dioxins (EPA 8280A). Except for the volatile organic sludge analysis (EPA 8260) during the August 2003, surrogate recoveries for all analyses were found to be within the QC recovery limits specified by the method. During August 2003, internal standards chlorobenzene-d5 and 1,4-dichlorobenzene-d4 were outside of criteria due to matrix interference. The samples were re-analyzed and the recoveries confirmed. The associated laboratory control samples were within limits.

Matrix spike (MS), matrix spike duplicates (MSD), laboratory control spike (LCS) and duplicate control spike (DCS) are samples and blanks that are spiked with target compounds of interest to determine percent recovery and relative percent difference between duplicates. The QC criteria include an acceptable recovery range and an RPD that should not be exceeded. Total metals, dissolved metals, cyanide, volatile organic compounds, and semi-volatile organic met QC criteria with few exceptions for MS, MSD, LCS, and DSC for all analyses on the program. Exceptions included the volatile (EPA 624) organic analyses conducted for the June 2003 sampling where 0% recovery for the compound 2-Chloroethyl vinyl was noted and a high RPD for 2378-TCDD (EPA 8280) during the August 2003 sampling although both recoveries were within laboratory limits. Surrogate recoveries were good and within acceptance limits with few exceptions. Detailed case narratives were provided by each laboratory which fully detail all QC issues for both sampling efforts and explain any QC deviations; these are provided in Appendix A2, A3, B2 and B3. Volatile aromatic hydrocarbon (EPA 602) analysis conducted for the summer dry and summer wet samplings noted all MS, MSD, LCS, or DCS recoveries to be within acceptable limits.

Trace metals analyses for the influent, effluent, sludge, and receiving water testing were supported through the use of SRMs, which are quality control reference materials with known metals values that are obtained from the National Bureau of Standards, National Institute of Standards and Technology, or other certified standards. These SRMs are analyzed by the laboratories at the same time as the project samples in order to ensure laboratory accuracy. Results of the analyses of SRMs should fall within acceptable limits and can be expressed as percent recovery. Except for nickel and lead in the seawater SRM for the receiving water program, all metals SRM results were within acceptance limits. Nickel recovery was low in the SRM, however the matrix spike recovery and duplicate precision were well within acceptance limits. The low levels of this metal certified in the SRMs are at levels one to two orders of magnitude less than the receiving water limits of 8.2 µg/L for nickel. Lead was found to have a

high recovery in the seawater SRM which was found to fall within limits if it were blank corrected. These recovery problems were not seen in the 1640 SRM analysis performed for these metals, and data quality was not judged to be adversely affected. In addition, SRMs were also analyzed for TSS and cyanide receiving water samples and found to be within acceptance recovery limits (Appendix D1).

Method blanks (or procedural blanks) were also analyzed for most analyses on the program. Method blanks consist of pure, organic- or metal-free reagent water that is run through the analysis process and used to verify that analyte concentrations are accurate and do not reflect contamination. With the exception of the ultra-trace level metals analyses that were conducted as part of the receiving water program, all method blanks results for the program showed no contamination during 2003. The method blank analyses for the ultra-trace level metals in the receiving water showed very small amounts of the various metals, most of which were present at levels below detection limits (Appendix D3). Copper and lead were the only metals which exceeded the detection limit. Copper concentration in the blank was an order of magnitude less than any of the dissolved concentrations found in the receiving water. The SRM results for copper fell within acceptance limits, and no further action was necessary. Lead was seen at a concentration of 0.0225 µg/L in the preconcentration blank, and the SRM results required blank correction to fall within acceptance limits. Therefore, the lead data were qualified with a "B" denoting blank contamination but are not blank corrected in this report. The lead concentration in the blank was less than but similar in magnitude to the concentrations seen in the dissolved fraction of the receiving water.

Although the method blanks for the June and August 2003 volatile organic analyses (EPA 624) did not indicate any contamination, laboratory contamination may have occurred as methylene chloride was noted in the field blank that consisted of HPLC grade DI water; data were appropriately qualified. The method blank analyses performed with the TSS and cyanide analyses showed no results above method detection limits. In addition to the typical method blanks, buffered dilution water was used as a blank for fecal coliform and enterococci bacteriological analyses. All blanks run for fecal coliform and enterococci showed no growth.

5.0 DISCUSSION

5.1 INFLUENT, EFFLUENT, AND SLUDGE MONITORING

The NPDES permit for the Asplund WPCF requires compliance with applicable State water quality standards as promulgated in Chapter 70 of the Alaska Administrative Code entitled "Water Quality Standards" (18 AAC 70; ADEC, 1999). This chapter requires that criteria outlined in "EPA Quality Criteria for Water" (also known as "The Red Book"; EPA, 1976), the revised quality criteria for water published in 1986, and other applicable criteria as referenced in the AWQS be met in applicable receiving waters at every point outside of the ZID boundary. Also, as noted in Section 1.1.1, the State of Alaska water quality regulations include SSWQC for the Point Woronzof area of Cook Inlet for turbidity and the dissolved fraction of arsenic, cadmium, hexavalent chromium, copper, lead, mercury, nickel, selenium, and silver. However, at this time EPA has not approved the SSWQC for acute nickel, acute and chronic selenium, and acute zinc since Alaska remains in the National Toxic Rule (NTR) for these pollutants. It is expected that Alaska will be removed from the NTR and the SSWQC approved by EPA for these metals in the near future. Therefore, we have used the SSWQC to evaluate the data in this report. Finally, the permit itself includes some effluent limitations that must be met. The following sections discuss the parameters of concern in regards to the requirements of the NPDES permit or the AWQS as well as historical data from the WPCF, data from other publicly-owned treatment works (POTWs), or other EPA data.

5.1.1 Influent and Effluent Monitoring

Table 24 lists permit effluent limitations and water quality criteria that are applicable to the current NPDES permit; it includes each of the parameters required to be monitored by the permit. Most of the values shown are the chronic toxicity criteria for salt water aquatic life. Chronic toxicity criteria concentrations are lower than acute toxicity criteria concentrations; therefore, the more stringent of the two values were used here for comparison. The MAEC for each constituent was calculated from the outfall design dilution factor of 142:1 (for conservative substances) or 180:1 (for non-conservative substances), the water quality criteria, and the natural background concentrations as determined at the control site near Point MacKenzie. It was assumed that the final effluent would be diluted by a minimum factor of 142 by the time it reached the boundary of the ZID. For most metals, the MAECs were calculated from the SSWQC for dissolved metals contained in the AWQS for the Point Woronzof area.

To determine compliance with State water quality standards, Table 24 can be compared with effluent values found in through Table 13 as well as those in Table 18 and Table 19. The AWWU 2003 maximum effluent concentrations shown in Table 24 were the maximum encountered during the calendar year either during AWWU's in-plant monitoring, the toxic pollutant and pesticide monitoring events, pretreatment monitoring, or the receiving water sampling event. For metals, both total and dissolved concentrations in the effluent were compared against their MAEC, since it is assumed that all of the metals contained in the effluent are potentially bioavailable upon entering the receiving water. All effluent concentrations were found to be much lower than the MAECs from the permit or computed from the water quality standards provided for in the AWQS. In addition, the permit limitations for all but one parameter (fecal coliform) were met for the 2003 program year. Individual parameters are discussed more fully below.

Table 24. NPDES Requirements, State of Alaska Water Quality Standards, and AWWU 2003 Maximum Concentrations for Effluent Comparisons. Non-compliant values are shown in **bold** type.

Parameter	Receiving Water Quality Standard[a]		Maximum Allowable Effluent Concentration[b] (MAEC)	AWWU 2003 Maximum Effluent Concentration[c]
Antimony (µg/L)	146	Human health, not listed for saltwater aquatic life	20,607	ND (10)[d]
Arsenic (µg/L)	36	Chronic toxicity, measured as dissolved	4,882	10.4[f]
Beryllium (µg/L)	11	For the protection of aquatic life in soft fresh water	1,513	0.11[e]
Cadmium (µg/L)	9.3	Chronic toxicity, measured as dissolved	1,322	0.9[d]
Chromium (VI)[i] (µg/L)	50	Chronic toxicity, measured as dissolved	7,038	7[e]
Copper (µg/L)	3.1	Chronic toxicity, measured as dissolved	317	65[e]
Lead (µg/L)	8.1	Chronic toxicity, measured as dissolved	1,140	7[d,e]
Mercury (µg/L)	0.025	Chronic toxicity, measured as dissolved	2.73	0.17[e]
Nickel (µg/L)	8.2	Chronic toxicity, measured as dissolved	978	13[d,e]
Selenium (µg/L)	71	Chronic toxicity, measured as dissolved	10,136	ND (10)[d]
Silver (µg/L)	1.9	Acute toxicity, measured as dissolved	257	3.9[e]
Thallium (µg/L)	2,130	Acute toxicity to saltwater aquatic life	306,567	ND (10)[d]
Zinc (µg/L)	81	Chronic toxicity, measured as dissolved	11,249	100[e]

Table 24. NPDES Requirements, State of Alaska Water Quality Standards, and AWWU 2003 Maximum Concentrations for Effluent Comparisons. (continued) Non-compliant values are shown in **bold** type.

Parameter	Receiving Water Quality Standard[a]		Maximum Allowable Effluent Concentration[b] (MAEC)	AWWU 2003 Maximum Effluent Concentration[c]
Cyanide (µg/L)	1	For marine aquatic life	181	ND(10)[e]
Total Aqueous Hydrocarbons (TAqH) (µg/L)	15	Growth and propagation of fish, shellfish, aquatic life, and wildlife including seabirds, waterfowl, and furbearers [g]	2,715	25.59 [f]
Total Aromatic Hydrocarbons as BETX (µg/L)	10	Same as above [g]	1,810	26.4[d]
pH (pH units)		*h*	6.5 - 8.5	6.6 – 8.1 [j]
Total Residual Chlorine (TRC) (mg/L)		*h*	Daily Max. 1.2	Daily Max 1.1 [j]
BOD_5 (mg/L)		*h*	Monthly Avg. 240 Weekly Avg. 250 Daily Max. 300 Removal Rate >30 %	Monthly Avg. 170 [j] Weekly Avg. 209 [j] Daily Max. 212 [j] Monthly Rate 10-61% [j]

Table 24. NPDES Requirements, State of Alaska Water Quality Standards, and AWWU 2003 Maximum Concentrations for Effluent Comparisons. (continued)
Non-compliant values are shown in **bold** type.

Parameter	Receiving Water Quality Standard[a]	Maximum Allowable Effluent Concentration[b] (MAEC)	AWWU 2003 Maximum Effluent Concentration[c]
Total Suspended Solids (TSS) (mg/L)	*h*	Monthly Avg. 170 Weekly Avg. 180 Daily Max. 190 Removal Rate >30%	Monthly Avg. 52 *j* Weekly Avg. 58 *j* Daily Max. 72 *j* Monthly Rate 64-89% *j*
Total Ammonia (mg/L)	9.8 *k*	1,774	Monthly Max. 23.5 *j*
Fecal Coliform (FC MPN/100 mL)	*h*	Monthly geometric mean of at least five samples shall not exceed 850. Not more than 10% of samples shall exceed 2600.	**Monthly geometric mean for July 2003 was 1141. More than 10% of the samples collected in June and July 2003 exceeded 2600.** *j*

a Alaska Administrative Code, 1999. Water Quality Standards, Chapter 70 (18 AAC 70)
b For conservative substances, effluent water quality criteria were determined by assuming a dilution of 142:1 at the ZID boundary, where: MAEC = 142 * (Criteria - Natural Background Concentration) + Criteria; pollutant concentrations in the effluent should not exceed these values. For non-conservative substances, a dilution of 180:1 was utilized in the MAEC calculation.
c For metals, the maximum effluent concentration was determined from both total and dissolved concentrations.
d Values from June 2003 or August 2003 toxic pollutant and pesticide samplings.
e Values from AWWU's pretreatment program.
f Values from effluent tested during receiving water sampling event.
g Alaska Administrative Code, 1999. Water Quality Standards, Chapter 70 (18 AAC 70).
h MAECs are not based on water quality criteria but instead are specified in MOA's 2000 NPDES permit.
i All samples tested as total chromium.
j Values from AWWU's in-plant monitoring.
k Ammonia receiving water criteria based on pH of 8.0, temperature of 15.0° C, and salinity of 20‰.

MGD Million gallons/day.

When the MAECs in Table 24 were compared to AWWU's self-monitoring effluent data, the toxic pollutant and pesticides sampling events (June 2003 and August 2003), the pretreatment monitoring data, and the effluent data from the receiving water quality sampling event, no metals or cyanide values exceeded their MAECs. The highest concentrations of either total or dissolved metals seen in 2003 were all well below their respective MAECs. The two metals that most closely approached their MAECs at any time were copper and mercury, and both of these were still seen at levels considerably below their MAECs. The maximum concentration of total copper was 65 µg/L compared to an MAEC of 317 µg/L. The highest dissolved copper concentration that was seen was 51 µg/L. The maximum concentration of total mercury seen was 0.17 µg/L, while the highest dissolved mercury was below detection limits (<0.1 µg/L) compared to an MAEC of 2.73 µg/L.

Those metals without SSWQC, while analyzed as both total and dissolved metals as called for by the permit, are compared to total recoverable metal MAECs as provided by EPA criteria and as called for by the AWQS. Total metals concentrations for antimony, beryllium, and thallium were generally low, often below detection limits, and all well below their MAECs. As in past years, total recoverable metals detected in the influent and final effluent of the Asplund WPCF were compared with data from an EPA study of 40 Publicly Owned Treatment Works (POTWs) in Table 25 (EPA, 1982). Without exception, metals and cyanide values were lower than or within the range of those detected in other POTWs from across the nation, even though the Asplund WPCF provides only primary treatment as compared to secondary treatment provided at the other plants.

Historic influent and effluent total recoverable metals and cyanide concentrations collected as part of AWWU's self-monitoring program are presented in Table 26 and Table 27. It should be noted that under the previous permit, the reporting year was November - October, which differs from the current permit's reporting period of the calendar year. In addition, prior to 2000 when the permit requirements changed, dissolved metals had only been analyzed in a single sample of effluent collected each year during the receiving water sampling. Beginning in August 2000, dissolved metals from the effluent have been analyzed in both the summer wet and summer dry sampling events. With few exceptions, concentrations are fairly consistent over time. Concentrations of total recoverable metals and cyanide concentrations seen in the influent and effluent during 2003 were generally found to fall within the range of concentrations seen during prior years. Concentrations of dissolved metals were generally found to fall within range of concentrations seen since August 2000 when this type of analysis was initiated.

During previous years, total copper levels would sometimes exceed the previous permit's MAEC of 100 µg/L. While this permit limit is no longer in effect, it is interesting to note that the maximum total copper concentration encountered in the effluent during the year 2003 (from the pretreatment monitoring) was considerably lower at 65 µg/L. The reasons for the elevated copper concentrations in previous years were investigated and reported to the Municipality by CH2M Hill and the AWWU laboratory. The conclusion of the copper investigation was that most of the copper in the influent is from the leaching of copper from residential plumbing rather than industrial discharge (CH2M Hill, 1987; CH2M Hill et al., 1988). Neither enforcement of the sewer ordinance (AMC 26.50) nor the industrial pretreatment program was expected to significantly reduce the amounts of copper received at the Asplund WPCF. The mass of copper in the plant influent and effluent remained fairly constant from 1986 through 1991. From 1991

Table 25. Comparison Between Influent/Effluent Analysis Results for Anchorage and 40 POTWs.[a] Values in brackets indicate results from EPA Method 602.

Parameter	Anchorage Values				40 POTW Study Values				
	2003 Concentration[b,c] (µg/L)				Frequency of Detection (%)		Range Detected (µg/L)		Influent Median
	Summer-Dry		Summer-Wet		Influent	Secondary Effluent	Influent	Secondary Effluent	(µg/L)
	INF	EFL	INF	EFL					
VOLATILES									
Benzene	ND[ND]	ND[ND/ND]	ND[ND]	ND[ND/ND]	61	23	1-1560	1-72	2
Bromomethane	ND[NT]	7.0J[NT]	ND[NT]	ND[NT]	NA	NA	NA	NA	NA
Chloroform	2.5J[NT]	3.8J[NT]	1.9JNT]	3.2J[NT]	91	82	1-430	1-87	7
1,4 Dichlorobenzene	ND[ND]	ND[ND/ND]	ND[1.4]	ND[1.2/1.2]	17	3	2-200	3-9	NA
Ethylbenzene	ND[1.5]	ND[1.8/1.1]	ND[ND]	ND[1.1/1.3]	80	24	1-730	1-49	8
Methylene chloride	7.9[NT]	4.1J[NT]	3.3J[NT]	2.9J[NT]	92	86	1-49000	1-62000	38
Tetrachloroethene	ND[NT]	ND[NT]	ND[NT]	ND[NT]	95	79	1-5700	1-1200	23
Toluene	12[9.9]	7.4[5.8/6.4]	4.7J[5.4]	5.3[9.0/9.6]	96	53	1-13000	1-1100	27
Xylene	ND[11]	5.1J[6.9/8.3]	ND[5.1]	ND[14/15]	NA	NA	NA	NA	NA
SEMI-VOLATILES[d]									
Bis(2-ethylhexyl)phthalate	18B	18B	11/9.8	13	92	84	2-670	1-370	27
Butyl benzyl phthalate	ND	3.0J	ND/ND	ND	57	11	2-560	1-34	3
Diethyl phthalate	7.1J	7.3J	9.9/9.9	11	53	13	1-42	1-7	3
Di-n-butyl phthalate	ND	1.6J	ND/ND	ND	64	52	1-140	1-97	4
Phenol	30	18	92/80.6	23	79	29	1-1400	1-89	7
TOTAL METALS & OTHER COMPONENTS									
Antimony	ND	ND	ND	ND/ND	14	13	1-192	1-69	NA
Arsenic	2	3	3	5	15	12	2-80	1-72	NA
Beryllium	ND	ND	0.11	0.07	3	1	1-4	1-12	NA
Cadmium	0.5	ND	0.8	0.7	56	28	1-1800	2-82	3
Chromium	3	7	5	2	95	85	8-2380	2-759	105
Copper	79	60	85	49	100	91	7-2300	3-255	132
Lead	10	7	5	2	62	21	16-2540	20-217	53
Mercury	0.19	0.13	0.3	0.1	70	31	0.2-4	0.2-1.2	0.517
Nickel	2	1	3	5	79	75	5-5970	7-679	54
Selenium	ND	ND	ND	ND/ND	9	10	1-10	1-150	NA
Silver	4.3	3.3	6.3	2.8	71	25	2-320	1-30	8
Thallium	ND	ND	ND	ND/ND	3	2	1-19	1-2	NA
Zinc	100	70	123	69	100	94	22-9250	18-3150	273
Cyanide	ND	ND	ND	ND	100	97	3-7580	2-2140	249

a Source: EPA, 1982. *Fate of Priority Pollutants in POTWs.* Final Report, Volume I, Effluent Guidelines Division, WH-552, EPA 440/1-82/303

b Data from NPDES 2002 toxic pollutant and pesticide monitoring

c Duplicate analyses provided for some analyses (value/field duplicate value)

d Only analytes detected above the detection limit in either the influent or effluent are included

B Also detected in associated method blank

J Estimated value

NA Not available

ND Not detected NT Not tested

Table 26. Comparison of Toxic Pollutants and Pesticides in Anchorage's Final Effluent to the Previous Five Years. Values in brackets are from EPA Method 602.

Pollutant	1998		1999		2000	
	Dry[c,d]	Wet[c]	Dry[c]	Wet[c]	Dry[c]	Dry[c]
	6/18-19	8/11-12	6/8-9	8/24-25	6/6-7	8/14-15
ORGANICS (µg/L)						
Benzene	ND[0.7/0.7]	ND[1.3/1.3]	ND[0.58/0.57]	3.0[ND/ND]	ND[ND/ND]	4.3[5.3/5.3]
* Benzoic Acid	ND	ND	NT	NT	NT	NT
Bis-(2-ethylhexyl)phthalate	9.6 J	15	11 J	21 B/ND[f]	ND	10
Bromomethane	ND	ND	ND	ND	ND	ND
Butyl benzyl phthalate	1.4 J	ND	3.6 J	ND	ND	ND
Chloroform	2.92	3.3	2.8	5.4	3.8	3.3
1,2-Dichlorobenzene	ND/ND/[1.3/1.4]	ND/ND/[1.9/0.72]	ND/ND/[17/ND]	ND/ND/ND/[ND/2.9]	ND/ND/[ND/11]	ND/ND/[9.5/8.0]
1,3-Dichlorobenzene	ND/ND/[ND/ND]	ND/ND/[ND/ND]	1.1/ND/[ND/ND]	ND/ND/ND/[ND/ND]	1.8/ND/[10/11]	ND/ND/[ND/ND]
1,4-Dichlorobenzene	1.2/ND/[4.3/4.2]	ND/ND/[8.8/9.9]	1.1/ND/[6.8/7.1]	1.6/ND/ND/[4.4/3.4]	ND/ND/[15/24]	ND/ND/[7.1/6.3]
Diethyl phthalate	1.7J	ND	8.0 J	ND	ND	ND
Di-n-butyl phthalate	1.3 J	ND	ND	ND	ND	ND
Di-n-octyl phthalate	1.7 J	ND	ND	ND	ND	ND
Ethylbenzene	0.06[0.5/0.5]	ND[1.5/1.5]	1.6[4.2/4.2]	2.6[ND/ND]	1.0[ND/ND]	4.1[6.5/6.3]
Methylene Chloride	3.35	7.2	6.8	5.7	3.8	1.8
Phenol	ND	12	ND	ND/49[f]	ND	ND
Tetrachloroethene	1.50	3.2	1.6	1.4	1.3	1.4
Toluene	8.6[6.4/6.3]	9.5[8.0/8.0]	12[18/17]	32[8.5/8.4]	10[7.0/6.8]	27[23/23]
* Total Xylenes	NT[2.6/2.6]	NT[9.8/9.9]	NT[28/28]	NT[2.6/2.4]	NT[10/6.3]	NT[37/37]
Total Hydrocarbons as Oil and Grease[a]	25000/25000	30000	7800/7200	11000	21200	20300
Total Petroleum Hydrocarbons[b]	1820/2090	2600	ND/ND	ND	ND/ND	ND
Total Aromatic Hydrocarbons as BETX[h]	10.6[10.21/10.11]	11.5[20.6/20.7]	14.6[50.8/49.8]	37.6[12.1/11.8]	12.0[18/14.1]	35.4[71.8/71.6]

Table 26. Comparison of Toxic Pollutants and Pesticides in Anchorage's Final Effluent to the Previous Five Years. (continued) Values in brackets are from EPA Method 602.

Pollutant	2001		2002		2003	
	Dry[c]	Wet[c]	Dry[c]	Wet[c,d]	Dry	Wet
	6/19-20	9/4-5	7/22-23	8/26-27	6/25-26	8/12-13
ORGANICS (µg/L)						
Benzene	1.62[ND/ND/ND]	1.99[ND/ND]	ND[0.58/0.59]	ND[ND/ND]	ND[ND/ND]	ND[ND/ND]
* Benzoic Acid	ND	109	NT	NT	NT	NT
Bis-(2-ethylhexyl)phthalate	22.9	272	11	8.9 J /21	18 B	13
Bromomethane	ND	ND	ND	ND	7.0 J	ND
Butyl benzyl phthalate	ND	ND	3.3 J	ND/ND	3.0 J	ND
Chloroform	2.98	3.60	4.3 J	4.8 J	3.8 J	3.2 J
* 1,2-Dichlorobenzene	ND/ND/[6.2/5.6/6.0]	ND/ND/[ND/ND]	ND	ND	ND[ND/ND]	ND[ND/ND]
* 1,3-Dichlorobenzene	ND/ND/[4.5/4.4/4.6]	1.27/ND/[ND/ND]	ND	ND	ND[ND/ND]	ND[ND/ND]
* 1,4-Dichlorobenzene	ND/ND/[1.1/1.1/1.1]	ND/ND/[1.7/1.7]	ND	ND	ND[ND/ND]	ND[1.2/1.2]
Diethylphthalate	ND	12.6	8.9 J	6.0 J/7.5 J	7.3 J	11
Di-n-butyl phthalate	ND	ND	2.9 J	ND/ND	1.6 J	ND
Di-n-octyl phthalate	ND	ND	ND	ND	ND	ND
Ethylbenzene	ND[ND/ND/ND]	2.40[ND/ND]	ND [0.62/0.61]	ND[0.80/0.81]	ND[1.8/1.1]	ND[1.1/1.3]
Methylene Chloride	ND	ND	5.0 B	0.94 J	4.1 J	2.9J
Phenol	ND	ND	24	11/ND	18	23
Tetrachloroethene	2.16	2.34	ND	0.95 J	ND	ND
Toluene	9.37[4.2/4.0/4.2]	8.95[8.0/7.7]	9.1[11/10]	8.2[6.2/6.4]	7.4[5.8/6.4]	5.3[9.0/9.6]
* Total Xylenes	2.42[ND/ND/ND]	12.51[ND/ND]	NT[3.0/2.8]	NT[5.7/5.8]	5.1 J[6.9/8.3]	ND[14/15]
Total Hydrocarbons as Oil and Grease[a]	21200	20400	21800	23500	24000	20100
Total Petroleum Hydrocarbons[b]	NT	NT	NT	NT	NT	NT
Total Aromatic Hydrocarbons as BETX[h]	13.6[5.7/5.5/5.7]	25.8[11.0/10.7]	NT[15.2/14]	18.2[13.2/13.5]	22.5[15.5/16.8]	25.3[24.6/26.4]

Table 26. Comparison of Toxic Pollutants and Pesticides in Anchorage's Final Effluent to the Previous Five Years. (continued) Values in brackets are from EPA Method 602.

Pollutant	1998		1999		2000	
	Dry[d]	Wet	Dry	Wet	Dry[c]	Dry[c]
	6/18-19	8/11-12	6/8-9	8/24-25	6/6-7	8/14-15
TOTAL METALS (µg/L)						
Antimony	ND	ND	ND	ND	ND	ND
Arsenic	3	13	3	3	ND	3
Beryllium	ND	ND	ND	ND	ND	ND
Cadmium	ND	ND	ND	15	ND	ND
Chromium	ND	ND	ND	ND	ND	10
Copper	60	49	70	50	54	53
Lead	3	8	5	3	4.8	8
Mercury	0.1	ND	0.2	ND	0.1	ND
Nickel	10	40	20	ND	ND	ND
Selenium	ND	ND	NT	ND	ND	ND
Silver	5.7	11.3	8.9	8.4	5.3	5.3
Thallium	ND	ND	ND	ND	ND	ND
Zinc	65	79	78	95	77	80
DISSOLVED METALS (µg/L)						
Antimony	NT	NT	NT	NT	NT	ND
Arsenic	NT	NT	NT	NT	NT	3
Beryllium	NT	NT	NT	NT	NT	ND
Cadmium	NT	NT	NT	NT	NT	6
Chromium	NT	NT	NT	NT	NT	ND
Copper	NT	NT	NT	NT	NT	39
Lead	NT	NT	NT	NT	NT	7
Mercury	NT	NT	NT	NT	NT	ND
Nickel	NT	NT	NT	NT	NT	20
Selenium	NT	NT	NT	NT	NT	ND
Silver	NT	NT	NT	NT	NT	0.4
Thallium	NT	NT	NT	NT	NT	ND
Zinc	NT	NT	NT	NT	NT	50
PESTICIDES (µg/L)						
Aldrin	ND/ND	ND	ND	ND	ND/ND/ND	ND/ND
alpha-BHC	ND/ND	ND	ND	0.067	ND/ND/ND	ND/ND
delta-BHC	ND/ND	ND	ND	ND	ND/ND/ND	ND/ND
4,4'-DDE	ND/ND	ND	ND	ND	ND/ND/ND	0.020/ND
Malathion	ND/ND	ND	0.13	6.7	ND/ND/ND	ND/ND
Parathion	ND/ND	ND	ND	0.56	ND/ND/ND	ND/ND
OTHER						
Cyanide (µg/L)	ND	ND	ND	ND	10	10.8
Asbestos (million fibers/L)[g]	ND	ND	ND	ND	ND	46

Table 26. Comparison of Toxic Pollutants and Pesticides in Anchorage's Final Effluent to the Previous Five Years. (continued) Values in brackets are from EPA Method 602.

Pollutant	2001		2002		2003	
	Dry	Wet[c]	Dry	Wet	Dry	Wet
	6/19-20	9/4-5	7/22-23	8/26-27	6/25-26	8/12-13
TOTAL METALS (µg/L)						
Antimony	ND	ND/ND	ND	ND/ND	ND	ND/ND
Arsenic	ND	ND	3	ND	3	5
Beryllium	ND	ND	ND	ND	ND	0.07
Cadmium	0.3	0.3	ND	0.4	ND	0.7
Chromium	4.1	3.2	1.5	3.0	7	2
Copper	56	39	60.4	61	60	49
Lead	6	6	6	9.0	7	2
Mercury	0.2	0.1	ND	ND	0.13	0.1
Nickel	3	4	4	3	1	5
Selenium	ND	ND/ND	ND	ND/ND	ND	ND/ND
Silver	10.7	6.0	6.4	6.0	3.3	2.8
Thallium	ND	ND/ND	ND	ND/ND	ND	ND/ND
Zinc	70	60	139	80	70	69
DISSOLVED METALS (µg/L)						
Antimony	ND	ND/ND	ND	ND/ND	ND	ND/ND
Arsenic	ND	7	ND	3	ND	4
Beryllium	ND	ND	ND	0.46	ND	ND
Cadmium	ND	0.3	0.5	0.2	ND	0.9
Chromium	0.6	ND	ND	1.7	ND	1
Copper	28	28	34.9	39	27	39
Lead	3	3	5	1	7	ND
Mercury	ND	ND	ND	ND	0.05	ND
Nickel	4	4	6	3.0	3	3
Selenium	ND	ND/ND	ND	ND/ND	ND	ND/ND
Silver	1.5	0.9	0.5	1.1	0.6	ND
Thallium	ND	ND/ND	ND	ND/ND	ND	ND/ND
Zinc	20	50	87	40	30	69
PESTICIDES (µg/L)						
Aldrin	ND/ND/ND	ND	ND	0.081	ND	ND
alpha-BHC	ND/ND/ND	ND	ND	0.10	ND	ND
delta-BHC	ND/ND/ND	ND	ND	0.86	ND	ND
4,4'-DDE	0.04/ND/ND/	ND	ND	ND	ND	ND
Malathion	ND/ND/ND	ND	ND	ND	0.31	ND
Parathion	ND/ND/ND	ND	ND	ND	ND	ND
OTHER						
Cyanide (µg/L)	ND	ND	ND	ND	ND	ND
Asbestos (million fibers/L)	20	13	20	6.6	ND	ND

a Method SM 503B (1997; 1998); method EPA 1664 HEM (1996; 1998; 1999; 2000; 2001)
b Method SM 503E (1997; 1998); method EPA 1664 SGT-HEM (1996; 1998; 1999; 2000; 2001)
c Duplicate effluent collected (field duplicate) or analyzed (lab duplicate) shown as value/duplicate value
d Values from EPA Method 624 are the result of averaging eight samples with zero used for ND (1998 Dry)
e Acetone was classified as a Tentatively Identified Compound in 1996
f First EPA 625 sample run showed contamination in method blank; second run (outside holding time) also reported (1999 Wet)
g Selenium tested by two laboratories shown as AWWU value, ToxScan value (1996; 1997)
h BETX calculated from EPA 624 for years 1998-2000 do not include xylenes as they were not tested
* Non-priority pollutants J Estimated value
B Compound also detected in method blank ND Not detected NT Not tested

Table 27. Historical Discharge Monitoring Data (1986 - Present) for Influent and Effluent Total Metals and Cyanide. Concentrations are in µg/L. Values represent average (Avg) or monthly minimum (Min) and maximum (Max) for 1996-1999 (program years running Nov. - Oct.) or a range of the results for years 1986-1995 as available. Results for 2000 include Avg., Min. or Max. of seven monthly values (Jan. - July) and pretreatment monitoring values (average of three results in August 2000). Results for 2001-2003 represent pretreatment monitoring values (average of three results from both wet and dry season sampling events).

Year	Average Flow (MGD)	Arsenic		Beryllium		Cadmium		Copper		Lead		Mercury		Nickel		Silver		Zinc		Chromium		Cyanide	
		Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.
1986-1997 Min	23	<1	<1	<0.1	<0.1	<0.5	<0.5	36	10	<1	<1	<0.2	<0.2	<1	<1	3	1	54	38	<1	<1	<0.4	1
1986-1997 Max	40	26	16	0.3	0.2	20	30	280	150	76	50	3.0	1.5	60	60	30	98	260	240	112	120	85	50
1998 Avg	29	4	3	0.1	0.1	5	5	74	41	12	6	0.3	0.2	26	22	11.1	6.8	136	64	8	10	15	15
1998 Min	27	<2	<2	<0.1	<0.1	<5	<5	60	30	4	<1	<0.2	<0.1	<20	<20	4.4	3.0	104	53	<5	<5	<10	<10
1998 Max	31	13	15	0.1	0.1	6	6	90	60	26	21	0.5	<0.2	77	40	16.1	11.1	182	88	10	16	<40	20
1999 Avg	29	4	3	0.2	0.2	6	6	91	57	22	7	0.5	0.2	28	22	7.1	4.9	142	77	11	12	<10	13
1999 Min	27	2	2	<0.1	<0.1	<5	<5	78	40	8	2	<0.1	<0.1	<20	<20	3.8	1.5	103	45	<10	<10	<10	<10
1999 Max	33	6	6	0.4	<0.4	17	10	120	70	149	15	1.5	0.4	50	40	12.6	7.9	197	114	20	20	<10	30
2000 Avg	29	6	3	<0.1	<0.1	<5	<5	84	46	11	8	0.3	<0.1	20	20	13.0	6.0	130	70	<10	<10	<10	<10
2000 Min	27	3	<3	<0.1	<0.1	<5	<5	60	30	6	<1	<0.1	<0.1	<20	<20	2.1	2.4	80	50	<10	<10	<10	<10
2000 Max	34	19	4	<0.1	<0.1	9	10	129	60	24	27	0.6	0.2	40	50	30.4	10.5	170	100	10	10	<10	10
2001 Avg	28	4	3	0.04	0.03	0.6	0.4	84	48	14	8	0.3	0.1	7	4	11.4	7.2	140	70	5	3.5	<10	<10
2001 Min	26	<3	3	<0.03	<0.03	0.4	0.2	82	39	8	4	0.2	<0.1	4	3	10.2	5.5	130	60	3.4	3.0	<10	<10
2001 Max	30	5	5	0.06	<0.03	0.7	1.0	88	56	27	19	0.4	0.2	10	6	12.9	10.7	150	80	6.2	4.1	<10	<10
2002 Avg	29	4	3	0.12	.082	0.5	0.4	92	63	10	6	0.4	0.1	6	4	9	6	165	158	4	3	10	10
2002 Min	27	3	3	0.06	<0.04	0.4	0.4	77	59	7	5	0.1	<0.1	5	3	7	4	110	80	3	1.5	<10	<10
2002 Max	34	4	3	0.22	0.21	0.6	<0.5	108	68	12	9	1.6	0.1	9	5	13	11	239	407	6.7	4.1	<10	<10
2003 Avg	28	3	3	0.09	0.09	0.8	0.6	88	57	11	5	0.3	0.1	4	5	5.6	3.3	133	79	5	3	<10	<10
2003 Min	26	1	1	0.07	0.07	0.5	<0.5	79	49	5	2	0.2	0.1	2	<1	4.3	2.7	100	69	2	2	<10	<10
2003 Max	31	5	5	0.11	0.11	1.0	0.7	110	65	19	7	0.4	0.2	6	13	6.7	3.9	151	100	9	7	<10	<10

Inf. Influent
Eff. Effluent
NT Not tested

to 1992, the in-plant copper loading dropped by approximately 25 %. The exact cause of this decrease is unknown; however, an increase in pH (to 8.0) at the Water Treatment Facilities (Ship Creek and Eklutna) during the Spring of 1991 caused a decrease in copper concentrations taken from "first draw" residential water sources in Anchorage. This increase in alkalinity was implemented to reduce corrosion in the drinking water distribution system. It would follow that these decreased values in drinking water would also affect the influent concentrations.

Total arsenic concentrations in the final effluent had remained fairly steady over the last five years, and 2003 values remained well within the range of those values seen before. The maximum total arsenic concentration in final effluent seen during 2003 was 10.4 µg/L, compared to an MAEC of 4,882 µg/L (Table 24). Arsenic values are not a serious concern for this permit in terms of effluent concentrations, since the concentration in the final effluent is so much lower than the MAEC.

During 2003, less than 10 µg/L of cyanide was reported in the effluent during the pretreatment monitoring efforts (reported as <10 µg/L or <MDL), well below the MAEC of 181 µg/L. The concentrations of cyanide in the effluent were also reported as <10 µg/L during the June 2003 and August 2003 samplings. Cyanide concentrations in the effluent collected during the receiving water sampling were reported as 2.1 and 1.82 µg/L in the sample and the laboratory duplicate, respectively. Cyanide had been a constituent of concern in past years because it approached or even exceeded the prior MAEC of 50 µg/L in some years. In 1986 it was observed that the effluent cyanide concentrations often exceeded the influent concentrations by an order of magnitude. This trend continued during subsequent years of sampling and was the subject of a special investigation conducted by the AWWU. The conclusion of this investigation was that the measured increase in cyanide between the influent and effluent was the result of the treatment plant's incinerator. Cyanide formed in the incinerator during sludge incineration is returned to the plant during the stack scrubbing process (CH2M Hill, 1987; CH2M Hill in association with Loren Leman, P.E., 1988). Subsequently, cyanide decreased and this was believed to be due to the change in the scrubbing water source from recirculated primary effluent to well water.

The most restrictive criteria of growth and propagation of fish, shellfish, other aquatic life, and wildlife was used for the hydrocarbon limits presented in Table 24. The MAECs for TAqH and total aromatic hydrocarbons as BETX were met again this year, with maximum levels in the effluent well below the state-specified limits. The parameter of TAqH was analyzed in effluent only during the receiving water quality sampling, and the TAqH concentration was 24.3 µg/L and 25.6 µg/L for the duplicate as compared to the MAEC of 2,715 µg/L. The maximum BETX value measured by the EPA 602 method of 26.4 µg/L was seen during the toxic pollutant and pesticide June 2003 sampling, and this value also fell well below the MAEC of 1,810 µg/L.

The MAEC for total ammonia was met this year, with effluent values exhibiting a maximum of 23.5 mg/L as compared to the MAEC of 1,774 mg/L. This MAEC is based on maximum criteria in saltwater of 9.8 mg/L based on a salinity of 20 ppt, temperatures of 15°C, and a pH of 8.0 units (EPA, 1989).

In addition to the MAECs based on the State and Federal water quality criteria, a number of other effluent limitations are specified in the NPDES permit. These daily, weekly, and monthly

limitations include pH, TRC, BOD_5, TSS, and fecal coliform (Table 24). All of the parameters except fecal coliform were found to be within their permit limitations for 2003.

For fecal coliform, the permit limitation of a monthly geometric mean (of at least five samples) that shall not exceed 850 FC MPN/100 mL was exceeded in July 2003, when the monthly geometric mean was reported as 1,141 FC MPN/100 mL. Fecal coliform exceeded the monthly criteria "that not more than 10 % of the effluent samples shall exceed 2600 FC MPN/100 mL during any month" in June and July 2003, when 14 and 33 % of the samples exceeded this value, respectively. Exceedences resulted from the continuing adjustment of the Oxidation Reduction Potential chlorine feed control system in an effort to optimize chlorine use. No other permit exceedences were noted during this reporting period.

The permit limitations for monthly and weekly averages and daily maxima were met for both BOD_5 and TSS. In addition, removal rates of at least 30 % were met for these two parameters as required under the amendments to the Clean Water Act (40 CFR; Final Rule, 8/9/94). Removal of BOD_5 averaged 36 % for the 2003 calendar year. Average removal rate of BOD_5 has decreased slightly over the last few years; this is suspected to be due to a greater percentage of soluble BOD_5 that cannot be removed by primary treatment processes. The average removal for TSS for this year was 80 %, about the same reported for the last six years and well above the requirement of 30 %.

Concentrations of other toxic pollutants and pesticides detected in the influent and final effluent were generally lower than or within the range of those detected in other POTWs from across the nation, even though the Asplund WPCF provides only primary treatment as compared to secondary treatment provided at the other plants (Table 25). The compound diethyl phthalate was detected in a higher concentration this year than that typically seen, with 11 µg/L being reported during the August 2003 sampling as compared to a typical range of 1 – 7 µg/L seen in secondary effluent. Toxic pollutants and pesticides also generally fell within the historical range of values seen in past years; levels of toxic pollutants and pesticides detected in the Anchorage effluent this year and over the previous five years are shown in Table 26. These data indicated some variability over time, but a generally similar pattern overall. Levels were low and often below reporting limits. As in the past, the types and concentrations of measured organic compounds varied between the two sampling periods. This is probably the result of different point sources discharging into the Municipality's wastewater system at various times. Also, in some instances, large differences in pollutant concentrations occurred between the influent and effluent. Inconsistencies can be explained by looking at sampling methodology and plant operation in the case of point-source contaminants. If spikes of contaminants are occurring in the influent, these might be hit or missed during sampling. On the other hand, an effluent sample could contain the contaminant because of mixing in the clarifiers. Differences in concentrations in influent and effluent samples could also be due to lower suspended sediment and particulates in the effluent samples. This can be seen in Table 11 and Table 12, where greater variability usually occurs in the influent concentrations as compared to the effluent.

Historic discharge monitoring data (1986 - 2003) for other parameters of concern measured in the influent and effluent are presented in Table 28. Most parameters have remained fairly steady over time. Dissolved oxygen levels had been steadily increasing since 1986 but showed a peak in 1992, with generally decreased levels over most of the last ten years, including 2003. The cause of the changes in DO levels is unknown, however, previous changes in sampling location

Table 28. Historical Discharge Monitoring Data (1986-Present) for Influent and Effluent Non-Metals. Values represent average (Avg) or monthly minimum (Min) and maximum (Max) for 1996-1999 (program years running Nov. - Oct.) or a range of the results for years 1986-1995 as available. Results for 2000-2003 include Avg., Min. or Max. of 12 monthly values (Jan. - Dec.).

Year	Temperature (°C)		pH[a]		TRC (mg/L)		DO (mg/L)		BOD_5 (mg/L)		TSS (mg/L)		Fecal Coliform (FC/100 mL)		Ammonia* (mg/L)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
1986-1997 Min	9	9	6.4	6.4	NA	0.6	NA	2.1	98	69	117	39	NA	5	NA	NT
1986-1997 Max	17	18	8.0	8.5	NA	1.0	NA	8.6	296	132	307	86	NA	726	NA	NT
1998 Avg	12	13	NA	NA	NA	0.8	NA	6.2	236	108	251	50	NA	23	NA	NT
1998 Min	10	11	6.4	6.5	NA	0.8	NA	5.6	184	91	204	44	NA	12	NA	NT
1998 Max	15	15	7.9	7.9	NA	0.9	NA	6.7	272	121	292	55	NA	44	NA	NT
1999 Avg	12.6	13.0	NA	NA	NA	0.8	NA	6.0	237	118	241	47	NA	71	NA	NT
1999 Min	10.3	10.5	6.5	6.7	NA	0.7	NA	4.8	203	102	217	41	NA	20	NA	NT
1999 Max	15.6	16.3	7.8	7.9	NA	0.9	NA	6.9	265	128	270	52	NA	201	NA	NT
2000 Avg	12.7	13.1	NA	NA	NA	0.8	NA	5.6	243	135	257	46	NA	83	NA	20.2
2000 Min	10.4	10.8	6.8	6.6	NA	0.7	NA	4.5	209	124	220	39	NA	9	NA	15.0
2000 Max	15.2	15.6	8.2	8.0	NA	0.8	NA	6.4	273	144	295	52	NA	252	NA	24.0
2001 Avg	13.3	13.7	NA	NA	NA	0.8	NA	6.2	243	142	243	46	NA	39	NA	21.0
2001 Min	11.1	11.5	6.9	6.7	NA	0.7	NA	5.2	225	125	223	37	NA	15	NA	13.8
2001 Max	16.0	16.3	7.8	7.6	NA	0.8	NA	6.8	284	156	267	61	NA	119	NA	29.3
2002 Avg	13.1	13.7	NA	NA	NA	0.4	NA	6.7	244	154	241	51	NA	179	NA	20.3
2002 Min	10.4	11.0	6.8	6.5	NA	0.3	NA	6.1	221	132	224	44	NA	32	NA	16.6
2002 Max	15.9	16.4	7.8	7.8	NA	0.5	NA	7.1	268	174	270	57	NA	462	NA	24.0
2003 Avg	13.6	14.0	NA	NA	NA	0.26	NA	4.9	252	161	235	48	NA	210	NA	21.8
2003 Min	11.4	11.2	6.9	6.6	NA	0.07	NA	3.8	228	155	215	44	NA	38	NA	20.3
2003 Max	16.1	17.1	7.8	8.1	NA	0.57	NA	6.3	269	170	252	52	NA	1141	NA	23.5

* NH3 testing began September 2000.

NA Not applicable

could account for some of the past increase. Other constituents of concern such as TSS have remained fairly steady in the effluent; influent TSS levels had increased during 1991 due to improved sampling methodology but have remained fairly steady since that time. The BOD_5 effluent average during 2003 (161 mg/L) was higher than that seen during prior years. However, BOD_5 levels in both the influent and effluent have shown a slight upward trend as a result of greater industrial contributors over the course of the program.

The yearly average effluent fecal coliform bacteria concentration reported at 210 FC MPN/100 mL for 2003 was the highest yearly average seen on the program to date. This is the result of a program to optimize chlorine usage as described below.

A project to improve the efficiency of the Asplund WWTF effluent disinfection system was implemented during 2001-2002. The existing chlorine injection process was changed by installation of rapid mixing equipment (the "Water Champ", installed in November 2001) to inject chlorine gas directly into the effluent. Oxidation Reduction Potential (ORP) technology using a *Strantrol 890 Controller* was installed in December 2001 to control the chlorine dosage rate by adjusting it in response to both flow and oxidation reduction potential of the wastewater. Prior to this improvement, it was never possible to determine an exact correlation between TRC and coliform kill. Dosage control by the ORP resulted in adequate coliform kills with far lower residuals in 2002, but optimizing the process to minimize chlorine usage, while assuring adequate fecal coliform kill, has been an on-going process. This reduced the annual chlorine usage from 666,059 pounds in 2001 to 594,699 pounds in 2002 and to 614,455 pounds in 2003. The usage reduction can be attributed to better mixing of the chlorine in the wastewater and more consistent control over the chorine dosage rate.

The average TRC had dropped from 0.8 mg/L in 2001 to 0.4 mg/L in 2002. Average TRC concentration fell even lower in 2003, to an average TRC value of 0.26 mg/L, with extremely low values of 0.09 and 0.07 mg/L reported in June and July 2003, respectively. The average fecal coliform monthly average rose from 39 FC/100 mL in 2001 to 180 FC/100 mL in 2002 to 210 FC/100 mL in 2003. As noted above, the three exceedences in 2003 of stated permit limits for fecal coliform were attributed to problems with the ORP control, as reported to EPA with the June and July 2003 DMRs.

In summary, effluent monitoring indicated that with the exception of fecal coliform, effluent concentrations of toxic pollutants and pesticides, metals and cyanide, and conventional parameters were much lower than their applicable permit limits or their MAECs. For fecal coliform, the monthly geometric mean requirement of not more than 850 FC/100 mL was not met in July 2003, and the criterion of not more than 10% of the samples exceeding 2600 FC/100 mL was not met in June and July 2003. These elevated fecal coliform levels were attributed to the control of the chlorination dosage system. In addition, all toxic pollutants and pesticides concentrations (including metals and cyanide) except diethyl phthalate were lower than or within the range of those detected at secondary treatment plants from across the nation.

5.1.2 Sludge Monitoring

The current permit requires sludge monitoring twice per year, once during the dry conditions in summer and once during wet conditions as part of the toxic pollutant/pretreatment monitoring. There are no Part 503 monitoring requirements included in the reissued permit. Additional sludge monitoring is required because the Part 503 regulations are self-implementing as described in Section 2.1.5. Therefore, monitoring at the Asplund WPCF includes Part 503 monitoring of sludge and has been included in this report (Table 15). In addition, a separate Part 503 monitoring report for the year 2003 will be submitted to EPA as required by 19 February 2004.

While limits for levels of toxic pollutants and pesticides in sludge are not part of the current permit, comparisons can be made for these data based on other treatment facilities' monitoring results. Again, data indicate that concentrations of toxic pollutants and pesticides in Anchorage sludge are generally lower than "typical" concentrations seen at other treatment facilities (Table 29). Like the last two years, the arsenic concentrations seen in sludge were less than those typically seen, with an average of 2.2 µg/g from the Part 503 monitoring as compared to a typical concentration of 4.6 µg/g. June 2003 and August 2003 values also fell below the typical concentration for arsenic at 2.9 and 1.9 µg/g, respectively. The average mercury concentration in sludge for the 2003 reporting year was 1.3 µg/g, below the typical concentration of 1.49 µg/g. The mercury concentrations seen during the June 2003 (1.6 µg/g) and August 2003 (2.13 µg/g) priority pollutant sampling events were below this typical concentration, but fell below the 95th percentile "worst case" concentration of 5.84 µg/g. The other Part 503 metals tested (beryllium, cadmium, chromium, and lead) fell below typical concentrations.

Selenium and nickel monitoring is not a requirement of the Part 503 regulations; however, these pollutants are monitored during the summer dry and summer wet sampling events. The selenium values reported for the sludge sample during the June 2003 and August 2003 sampling events were 2.41 and 3.35 µg/g, respectively, as compared to the typical concentration of 1.11 µg/g and a 95 th percentile concentration of 4.848 µg/g. The nickel concentration in June 2003 (52.9 µg/g) exceeded the typical concentrations of 44.7 µg/g but fell below the 95th percentile value of 662.7 µg/g. Nickel concentrations from the Part 503 sampling averaged 20 µg/g, and the nickel concentrations reported for the August 2003 sampling event was 16 µg/g, below the typical concentration.

Table 30 provides an overview of historical sludge data for total recoverable metals and cyanide. In general, year 2003 data indicated slightly lowered concentrations of arsenic, cadmium, chromium, and lead compared to historical data. Values reported in 2003 for mercury and nickel were generally the same as those reported in the past. Beryllium values appeared to increase slightly compared to historical values, but these values still fell well below the typical and 95 th percentile concentrations reported for beryllium (Table 29).

5.2 WATER QUALITY MONITORING

5.2.1 Plume Dispersion Sampling

To test the hypothesis that the water quality at the ZID boundary was not degraded with respect to the water quality at the nearfield and control stations, the non-parametric Kruskal-Wallis Test

Table 29. Comparison Between Sludge Analysis Results for Anchorage and Typical and Worse Case Concentrations Used by EPA in Developing Median or Mean Environmental Profiles[a]. All concentrations are in µg/g dry weight.

Pollutant	2003 Anchorage Values			Typical Concentration	95th Percentile "Worse Case"
	June[b]	August[b]	2003 AVG[c]		
Aldrin/Dieldrin	ND(0.026)/ND(0.026)	ND(0.025)/ND(0.050)	---	0.07	0.81
Arsenic	2.9	1.9	2.2	4.6	20.77
Benzene	ND(7.600)	ND(0.079)	---	0.326	6.58
Benzo(a)anthracene	ND(0.990)	ND(0.950)	---	0.68	4.8
Benzo(a)pyrene	ND(0.990)	ND(0.950)	---	0.14	1.94
Beryllium	0.19	0.23	0.15	0.313	1.168
Bis(2-ethylhexyl)phthalate	ND(0.990)	28	---	94.28	459.25
Cadmium	2.31	2.40	1.9	8.15	88.13
Carbon Tetrachloride	ND(7.600)	ND(0.079)	---	0.048	8.006
Chlordane (α,γ)	ND(0.026)	ND(0.025)	---	3.2	12
Chloroform	ND(7.600)	ND(0.079)	---	0.049	1.177
Chromium	17.3	19	14	230.1	1499.7
Copper	290	273	---	409.6	1427
Cyanide	0.8	0.7	---	476.2	2686.6
DDT/DDE/DDD	ND(0.0096)/ND(0.0096)/ND(0.0096)	ND(0.0094)/ND(0.0094)/ ND(0.0094)	---	0.28	0.93
3,3-Dichlorobenzidine	ND(2.000)	ND(1.900)	---	1.64	2.29
Methylene chloride	ND(15.000)	ND(0.160)	---	1.6	19
Endrin	ND(0.051)	ND(0.050)	---	0.14	0.17
Hexachlorobenzene	ND(0.990)	ND(0.950)	---	0.38	2.18
Hexachlorobutadiene	ND(0.990)	ND(0.950)	---	0.3	8
Lead	47.4	28.4	29	248.2	1070.8
gamma-BHC (Lindane)	ND(0.026)	ND(0.025)	---	0.11	0.22
Malathion	ND(0.064)	ND(0.063)	---	0.045	0.63
Mercury	1.6	2.13	1.3	1.49	5.84
Nickel	52.9	16	20	44.7	662.7
PCBs	ND(0.510)	ND(0.500)	---	0.99	2.9
Pentachlorophenol	ND(2.000)	ND(1.900)	---	0.0865	30.434
Phenanthrene	ND(0.990)	ND(0.950)	---	3.71	20.69
Phenol	3.300	ND(0.950)	---	4.884	82.06
Selenium	2.41	3.35	---	1.11	4.848
Tetrachloroethene	ND(7.600)	0.180	---	0.181	13.707
Trichloroethene	ND(7.600)	ND(0.079)	---	0.46	17.85
2,4,6-Trichlorophenol	ND(0.990)	ND(0.950)	---	2.3	4.6
Vinyl Chloride	ND(7.600)	ND(0.079)	---	0.43	311.942
Zinc	582	634	---	677.6	4580

a Source: EPA 1985c. *Summary of Environmental Profiles and Hazard Indices for Constituents of Municipal Sludge: Methods and Results*. Office of Water Regulations and Standards, Appendix F.
b Data from NPDES 2003 toxic pollutant and pesticide monitoring
c Average from 2003 Part 503 sludge monitoring results
--- Not monitored in-plant for Part 503
J Estimated value
NA Not available
ND ( ) Not detected (detection limit)
NT Not Tested.

ble 30. Historical Discharge Monitoring Data (1986 - Present) for Metals in Sludge. Concentrations are in mg/kg dry weight. Values represent average (Avg.) or monthly minimum (Min) and maximum (Max) for 1996-1999 (program years running Nov. – Oct.) or a range of the results for years 1986-1997 as available. Results for 2000 include Avg., Min., or Max. of seven monthly values (Jan. - July) and Part 503 monitoring values if available (two or three results in Aug. - Dec. 2000). Results for 2001-2003 represent Part 503 sludge monitoring and toxic pollutant monitoring values.

Year	Arsenic	Beryllium*	Cadmium	Chromium (Total)	Lead	Mercury	Nickel
1986-1997 Min	1.7	<0.02	1.2	3.38	32	<0.1	<8
1986-1997 Max	151	0.22	10.0	48	468	7.3	42
1998 Avg	18.0	0.10	3.0	20	70	1.5	18
1998 Min	3.6	0.07	0.7	5	33	0.7	11
1998 Max	135.8	0.14	5.2	55	294	2.9	26
1999 Avg	9.1	0.11	2.9	21	46	1.9	20
1999 Min	2.2	0.02	1.1	12	32	0.9	10
1999 Max	36.1	0.18	5.2	28	88	4.0	28
2000 Avg	3.6	0.13	2.5	22	37	1.6	21
2000 Min	2.1	0.09	1.8	12	24	0.8	12
2000 Max	4.8	0.19	3.2	49	53	3.2	27
2001 Avg	3.1	0.15	2.6	17	43	1.1	17
2001 Min	2.4	0.12	2.0	12	26	0.5	15
2001 Max	4.0	0.21	3.4	22	91	2.0	19
2002 Avg	2.7	0.13	2.6	20	32	1.2	16
2002 Min	2.1	0.08	2.0	16	22	0.8	10
2002 Max	3.3	0.21	3.6	25	50	3.2	22
2003 Avg	2.2	0.15	1.9	14	29	1.3	20
2003 Min	1.7	0.07	0.7	8	19	0.9	7
2003 Max	2.9	0.23	2.7	19	47	2.1	53

* Beryllium testing began in 1993

(Zar, 1984) was employed which determined whether significant differences occurred within the sample group. If significant differences were observed, Dunn's test, a test that performs pair-wise tests of significance (alpha = 0.05), was employed (Dunn, 1964). The results of these tests for the June survey period as a function of water quality parameters are presented in Table 31. Non-detect values were replaced with the detection limit value for statistical testing.

Data from the receiving water survey showed statistically significant difference between outfall and control stations for temperature, salinity, and pH at some of the depths. Temperature was found to have significant differences between the control and each outfall group for the surface depth and between the control and the nearfield outfall stations at the middle depth. These differences in temperatures are the result of the control location being warmer than the outfall locations. Similarly, salinity was found to be significantly different between the control and all three outfall station groupings for the surface depth and between the control and the within-ZID and nearfield outfall stations for the middle and bottom depths. This difference was the result of the control stations being fresher (less saline) as a result of increased river influence on the north side of Knik Arm. This pattern of warmer, less saline water at the control site has been seen numerous years in the past. Statistical analyses indicated significant differences between the control and the nearfield outfall stations at the surface depth for pH, with no significant differences noted at the middle and bottom depths. Review of the data show that the pH values at the control stations were slightly lower than those at the outfall nearfield stations. All pH values fell within the AWQS of 6.5 - 8.5 and did not vary more than 0.2 pH units, as required by the AWQS. It is likely that, as in the past, very small differences in pH can be attributed to the natural variability in the two water masses being sampled. Turbidity was not found to be significantly different between the control site and the outfall stations at any depth.

No statistically significant differences were noted between the control and the outfall station groupings for TRC results. However, statistical analyses for color and fecal coliform indicated significant differences between the control stations and the within-ZID, ZID boundary, and nearfield outfall stations. All color values reported at the control sites were below the MDL of 5 color units, while values at the outfall stations ranged from 5 to 15 color units. Fecal coliform values were below 11 FC/100 mL at the control stations but ranged from 4 – 900 FC/100 mL at the outfall stations. Increases in fecal coliform concentrations at the outfall stations may be attributed to the outfall as concentrations in area creeks were quite low this year. However, intertidal concentrations of fecal coliform were also lower than usual this year, indicating that outfall impacts may be limited.

In addition to the standard water quality sampling, concentrations of total aromatic hydrocarbons as BETX and TAqH were measured at the surface at six stations (three at the flood tide control site and three at the flood tide outfall site, along the first drogue track). No statistically significant differences in BTEX concentrations were detected between the control and outfall stations. No BTEX concentrations above MDLs were seen at any of the control stations or at Stations F1-1 and F1-3, while elevated levels of BTEX (30.2 µg/L, in excess of the State of Alaska water quality standard of 10 µg/L) were seen at the ZID-boundary station (F1-2). Due to the high number of non-detects for this parameter, the statistical testing was unable to detect differences in BTEX concentrations, although a visual inspection of the data indicates that BTEX values were elevated at Station F1-2. A statistically significant difference was, however, seen in concentrations of TAqH between the control and outfall stations, although this could not be directly attributed to the outfall since concentrations in the effluent were low and TAqH levels

Table 31. Significant Station Pairs at the 5 % Significance Level Using the Kruskal-Wallis and Dunn's Tests.

Parameter	Sample Depth		
	Surface	Middle	Bottom
Temperature*	1,4 / 2,4 / 3,4	3,4	NS
Salinity*	1,4 / 2,4 / 3,4	1,4 / 3,4	1,4 / 3,4
Dissolved Oxygen*	NS	NS	NS
pH*	3,4	NS	NS
Turbidity*	NS	NS	NS
Color Units*	1,4 / 2,4 / 3,4	----	----
Fecal Coliform*	1,4 / 2,4 / 3,4	----	----
Total Residual Chlorine*	NS	----	----
Arsenic**	**SIG**^{D}, **SIG**^{TR}	----	----
Cadmium**	**SIG**^{D},NS^{TR}	----	----
Chromium**	NS^{D}, NS^{TR}	----	----
Copper**	**SIG**^{D},NS^{TR}	----	----
Mercury**	**SIG**^{D},NS^{TR}	----	----
Nickel**	NS^{D}, NS^{TR}	----	----
Lead**	NS^{D},NS^{TR}	----	----
Silver**	NS^{D},NS^{TR}	----	----
Zinc**	**SIG**^{D},NS^{TR}	----	----
Cyanide**	NS	----	----
Total Suspended Solids**	**SIG**	----	----
Total Aromatic Hydrocarbons (BETX)**	NS	----	----
Total Aqueous Hydrocarbons (TAqH)**	**SIG**	----	----

* Statistics performed on Group 1: Within-ZID Stations; Group 2: ZID Boundary Stations; Group 3: Nearfield Stations; and Group 4: Control Stations.

** Statistics performed on stations along outfall Drogue F1 versus the control, Drogue C1.

---- Not Applicable (surface samples only)

NS Not Significant

SIG Significant

^{D} Dissolved

^{TR} Total Recoverable

were only elevated at one station. Levels of TPAH seen at the outfall stations were also higher than those seen at the control stations, but all TPAH levels were relatively low. While TAqH values were below the receiving water quality standard of 15 µg/L at Stations F1-1 and F1-3, the standard was exceeded at the ZID-boundary station (F1-2).

Total suspended solids, cyanide, and total recoverable and dissolved metals samples collected at the outfall and control sites were also subject to statistical testing. Significant differences were noted in concentrations of TSS and total recoverable arsenic. Although total recoverable arsenic, cadmium, copper, and silver concentrations were higher at the outfall stations than at the control, none of these differences proved to be statistically significant except for arsenic. Naturally high variability in the TSS concentrations was apparent.

For dissolved metals, statistically significant differences between control and outfall stations were seen for arsenic, cadmium, copper, mercury, and zinc; this was the result of the outfall stations being higher in these parameters. For the outfall stations, concentrations of these metals, with the exception of dissolved mercury, were highest at Station F1-1 (within ZID). This appeared to be due to influence of the outfall discharge. Concentration of dissolved chromium, nickel, and lead were also highest at Station F1-1 among the outfall stations, but differences between the outfall and control stations levels were not statistically significant.

A comparison of the water quality data listed in Table 17 with the marine receiving water quality for the State of Alaska (Table 24 and Table 32) indicates that none of the parameters listed in Table 17 exceeded the State's standards. As noted in Section 3.2.1, all of the TRC concentrations were at or below the MDL of 0.005 mg/L, except at one station which was located within the ZID (F1-1). It should be noted that the method detection limit achievable for TRC analysis (0.005 mg/L) is higher than the State-specified limit of 0.002 mg/L (for salmonid fish). As noted in Section 3.2.2, although the amperometric method that was used is the preferred method due to fewer interferences, all TRC methods are subject to positive interferences in estuarine or marine waters. In fact, in past years, some of the highest TRC levels were seen at the control stations.

The State's receiving water quality standard for the "growth and propagation of fish, shellfish, aquatic life, and wildlife including seabirds, waterfowl, and furbearers" is 15 µg/L for TAqH and 10 µg/L for total aromatic hydrocarbons as BETX. As seen in Table 19, these standards were exceeded during the sampling at Station F1-2, at the ZID boundary. For the three control stations and the other two outfall stations, BETX was reported as not detected, with method detection limits well below the state standards. TAqH values also exceeded state standards at Station F1-2. In addition, for "contact recreation", the AWQS for hydrocarbons is as follows: "Shall not cause a film, sheen, or discoloration on the surface or floor of the water body or adjoining shorelines. Surface waters shall be virtually free from floating oils." No film, sheen, or discoloration was observed from the sampling vessel during the receiving water program in 2003. However, on September 4, 2003, during the annual beach tower sluice gate maintenance, grease and plastic debris were inadvertently discharged to the outfall. This resulted in a grease and debris line on the beach extending about 7,000 feet to the northeast. This incident was reported to EPA as required and the debris was immediately cleaned from the beach by AWWU.

All the dissolved metals tested in receiving water (Table 18) as part of this program met the AWQS as shown in Table 24. This included arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc. Testing of antimony, beryllium, selenium, and thallium in

Table 32. State of Alaska Water Quality Standards for Receiving Water.

Parameter	Most Restrictive Marine Water Quality Standards
Fecal Coliform	Based on a 5-tube decimal dilution test the fecal coliform median MPN shall not exceed 14 FC/100 mL (harvesting for consumption of raw shellfish); a geometric mean of 20 FC/100 mL (for aquaculture of products not normally cooked and seafood processing); and not more than ten percent (10%) of the samples shall exceed 40 FC/100 mL (aquaculture of products not normally cooked and seafood processing).
Dissolved Oxygen	Dissolved oxygen concentrations in estuaries and tidal tributaries shall not be less than 5.0 mg/L except where natural conditions cause this value to be depressed.
pH	pH shall not be less than 6.5 or greater than 8.5, and shall not vary more than 0.2 pH unit from natural condition.
Turbidity	Turbidity may not exceed the natural condition.
Temperature	Temperature shall not cause the weekly average temperature to increase more than 1° C. The maximum rate of change shall not exceed 0.5° C per hour. Normal daily temperature cycles shall not be altered in amplitude or frequency.
Salinity	Maximum allowable variation above natural salinity: **Natural Salinity (‰)** / **Man-induced Salinity (‰)** 0 to 3.5 / 1 3.5 to 13.5 / 2 13.5 to 35.0 / 4
Sediment	No measurable increase in concentrations above natural conditions.
Color	Color shall not exceed 15 color units.
Petroleum Hydrocarbons, Oils and Grease	Total aqueous hydrocarbons (TAqH) in the water column shall not exceed 15 µg/L. Total aromatic hydrocarbons (TAH) in the water column shall not exceed 10 µg/L. Shall not cause a film, sheen, or discoloration on the surface or floor of the water body or adjoining shorelines. Surface waters shall be virtually free from floating oils.
Total Residual Chlorine	Concentrations shall not exceed 2.0 µg/L for salmonid fish or 10.0 µg/L for other organisms.
Toxic and Other Deleterious Substances	See Table 24.

receiving water is not required by the permit and was not performed this year. Previous years of monitoring showed exceedences of water quality criteria for total recoverable metals that were due to the specified test methods in conjunction with high amounts of suspended particulates in Cook Inlet. Since the adoption of the more-appropriate SSWQC for dissolved metals in May 1999, the receiving waters of Cook Inlet near the Asplund WPCF discharge have been in compliance with the AWQS.

With the exception of one sample, cyanide samples collected during the receiving water sampling were all below the detection limit of 1 µg/L as compared to the State-specified criteria of 1 µg/L for marine aquatic life. The cyanide concentration measured within the ZID at Station F1-1 was reported at 2.0 µg/L. Cyanide concentrations in the effluent were reported at 2.1 and 1.82 µg/L for the sample and laboratory duplicate, respectively, well below the MAEC of 181 µg/L.

In summation, statistical analyses of the 2003 receiving water quality data indicated that water quality outside the ZID was not degraded with respect to control stations for most parameters. Differences that were noted in some parameters such as temperature, salinity, pH, and color, and TSS were unlikely to be influenced by the Asplund WPCF outfall. With the exception of TAqH and total aromatic hydrocarbons as BTEX, which exceeded the AWQS at the ZID-boundary station (F1-2), all AWQS were met for the Asplund WPCF receiving water quality program. Total aromatic hydrocarbons as BTEX were clearly elevated at Station F1-2, and therefore, TAqH was also elevated at that station. Elevations in hydrocarbon concentrations could not be directly attributed to the outfall as concentrations in the effluent were low and elevated levels were only seen at one station. No statistically significant differences were seen for BETX hydrocarbon concentrations between the outfall and control locations: however, a statistically significant difference was seen in concentrations of TAqH. Statistically significant increases in dissolved arsenic, cadmium, copper, mercury, and zinc were seen between control and outfall stations; however, all concentrations were well below the AWQS. Statistically significant differences between control and outfall stations were not seen for the total recoverable metals with the exception of arsenic. Many of the total recoverable metals were reported at higher concentrations at the control stations than at the outfall; differences in total recoverable metals were more not attributed to the outfall but were more likely attributable to natural variation in TSS concentrations in Knik Arm. All metals concentrations were well within AWQS.

5.2.2 Fecal Coliform Bacteria

The ADEC has indicated that one of their primary concerns is bacterial contamination of the shoreline by the Asplund discharge, indicated by fecal coliform bacteria concentrations. Because the Knik Arm's water uses have not been classified, regulations provide that the most restrictive standard must apply. State marine water quality standards for contact recreation require that the geometric mean fecal coliform concentration taken within a 30-day period not exceed 100 FC MPN/100 mL and that not more than one sample, or more than 10 % of the samples if there are more than 10, exceed 200 FC MPN/100 mL. Criteria for secondary recreation and for industrial water supply require that the mean fecal coliform concentration not exceed 200 FC MPN/100 mL and that not more than 10 % of the samples exceed 400 FC MPN/100 mL. State marine water quality criteria for the harvesting for consumption of raw mollusks and other raw aquatic life require that, based on a 5-tube decimal dilution test, the median shall not exceed 14 FC MPN/100 mL and that not more than 10 % of the samples shall exceed 43 FC MPN/100 mL.

For seafood processing water supply for products not normally cooked, criteria are that the geometric mean may not exceed 20 FC MPN/100 mL and not more than 10 % of the samples exceed 40 FC MPN/100 mL, and 200 and 400 FC MPN/100 mL for products normally cooked, respectively. For aquaculture water supply, criteria are that the geometric mean may not exceed 20 FC MPN/100 mL and not more than 10 % of the samples may exceed 40 FC MPN/100 mL.

Since the harvesting of shellfish and other raw aquatic life is not performed in these waters and there is no aquaculture or seafood processing, it seems that the criteria for secondary recreation is most applicable; however, these criteria are not the most restrictive. Therefore, the most restrictive criteria used were that the median shall not exceed 14 FC MPN/100 mL (consumption of raw shellfish and other aquatic life), the geometric mean shall not exceed 20 FC MPN/100 mL (seafood processing and aquaculture for raw consumption), and not more than 10 % shall exceed 40 FC MPN/100 mL (seafood processing and aquaculture for raw consumption; Table 32).

Statistical tests indicated that fecal coliform concentrations were significantly different between the within-ZID, ZID boundary, and the nearfield outfall station groups as compared to the control stations (refer to Table 31), with higher concentrations exhibited at the outfall stations. Fecal coliform concentrations values ranged from 4 to 900 FC MPN/100 mL at the outfall stations (including the ZID stations) compared to range of 2 to 11 FC MPN/100 mL at the control stations. The median at the control stations was 4 FC MPN/100 mL. The median at the outfall stations outside the ZID for both ebb and flood tides was 50 FC MPN/100 mL, above the 14 FC MPN/100 mL criterion. The control site had a geometric mean of 5.2 FC MPN/100 mL, while that at the outfall stations outside the ZID was 56.5 FC MPN/100 mL, above the criterion of 20 FC MPN/100 mL. Ten out of 18 measurements (56 %) at the outfall stations outside the ZID exceeded 40 FC MPN/100 mL, compared to the criteria of not more than 10 % of the measurements may exceed 40 FC MPN/100 mL. While the highest fecal coliform concentration (900 FC MPN/100 mL) was seen at the within-ZID Station F1-1, the next highest value (500 FC MPN/100 mL) was seen at the farfield Station E1-4, over one nautical mile from the outfall. The next highest value (300 FC MPN/100 mL) was seen at the ZID-boundary Station F2-2 and Station E1-3, nearly ¾ of a mile from the outfall.

High fecal coliform bacterial concentrations were seen in only one of the three creeks sampled. The two replicate fecal coliform concentrations measured in Fish Creek were both 70 FC MPN/100 mL. Replicate concentrations measured in Ship Creek were 11 and 13 FC MPN/100 mL, while those at Chester Creek were 4 and 13 FC MPN/100 mL.

The range of fecal coliform concentrations for all intertidal samples collected during 2003 was quite low at <2.0 to 30 FC MPN/100 mL, with a median of 10 FC MPN/100 mL and a geometric mean of 9.6 FC MPN/100 mL. These values met the most restrictive water quality criterion of a median of 14 FC MPN/100 mL and a geometric mean of 20 FC MPN/100 mL. The highest coliform concentrations were seen at Stations IT-5, 250 m south of the outfall; IT-1, 200 m east of the outfall; and IT-3, 750 m south of the outfall. Due to the varied distribution of these high values, it is not clear that they are an outfall related impact. The criterion of not more than 10 % of the samples exceeding 40 FC 100/mL was met, as none of the intertidal measurements exceeded this value. As in the past, some of the slightly elevated fecal concentrations seen intertidal may be the result of heavy waterfowl use of the area. Fecal coliform concentrations in the effluent samples collected in conjunction with the receiving water, intertidal sampling, and stream sampling were reported at 130 and 240 FC MPN/100 mL for the two replicates.

In summary, while elevated fecal coliform concentrations were seen during the offshore receiving water sampling at the outfall stations as compared to the control stations, with statistically significant differences seen between station groupings for the ZID, ZID-boundary, or nearfield stations as compared to the control location. Area creeks again exhibited slightly elevated fecal coliform concentrations as compared to all of the intertidal and many of the receiving water stations, indicating that receiving water concentrations may be influenced by runoff from these creeks. Fecal coliform samples collected at the outfall stations outside the ZID during the receiving water sampling program failed to meet the most restrictive receiving water standards: the median was 50 FC MPN/100 mL, above the 14 FC MPN/100 mL criterion; the geometric mean was 56.5 FC MPN/100 mL, above the criterion of 20 FC MPN/100 mL; and 56 % of sample exceeded 40 FC MPN/100 mL compared to the criteria of not more than 10 % of the measurements may exceed 40 FC MPN/100 mL. These elevated values may have been due the outfall, as the highest concentration encountered as seen at the within-ZID station. However, other stations more removed from the diffuser also showed high values, and other factors such as stream inputs may be influencing fecal coliform levels. All fecal coliform samples collected from intertidal areas met water quality criteria.

5.3 SEDIMENT QUALITY AND BIOACCUMULATION MONITORING

Intertidal sediment samples were collected for chemistry analyses from three intertidal stations, two in the vicinity of the outfall (Stations IT-1 and IT-2) and one at a control site directly across the Inlet from the outfall (Station IT-C). Chemical analyses indicated that all three sites were similar in sediment composition and levels of chemical parameters. The sediments were predominantly made up of silt and clay with moderate levels of organic material as shown in the TVS analyses. Most toxic pollutants and pesticides were found to be at or below detection limits, including all of the semi-volatile organic compounds, pesticides, asbestos, cyanide, and dioxins. A few volatile organic compounds normally associated with gasoline and other petroleum products were seen in one replicate, but these could not be attributed to the outfall. Cyanide was reported at 0.780 µg/g, just above the detection limit, in one replicate from Station IT-C.

Concentrations of metals were found to be very similar between sites and typical for marine sediments, with slightly lower concentrations at the control site that were associated with the lower TVS and organic content of the sediments at this location. Sediment metals concentrations were compared to the National Oceanic and Atmospheric Administration (NOAA) Status and Trends Effects Range-Low (ER-L), which is the level below which environmental effects are rarely seen, and Effects Range-Median (ER-M), which is the level above which environmental effects frequently occur (Long et al., 1995). Concentrations between these two levels represent the range where effects would occasionally occur. All metals concentrations were found to be substantially below their respective ER-M values, and there was no indication of sediments having been contaminated from any anthropogenic sources. Concentrations of arsenic, chromium, copper, and nickel exceeded ER-L levels at both the outfall and control sites; these comparatively elevated values were not attributed to the outfall but were thought to represent the natural levels associated with glacial silt in Cook Inlet.

Subtidal sediment sampling performed in 2003 confirmed past sampling effort results which indicated that the substrate in the vicinity of the outfall diffuser and at the control site consists

mainly of large cobble and lesser amounts of coarse gravel. Due to the coarse nature of the sediments, chemical analyses could not be performed on the subtidal samples as no fine-grained sediments were obtained from either location.

The bioaccumulation program was to include sampling of the yellow-green algae *Vaucheria* spp. from two intertidal locations. However, due to insufficient algae growth during the summer of 2003, the bioaccumulation program could not be performed. This algae is normally associated with brackish water and often is present near high tide level near river mouths or in areas of seepage and runoff of freshwater (Kozloff, 1993). Since the summer of 2003 was relatively dry with low runoff, it is speculated that the Upper Cook Inlet in the vicinity of Anchorage was higher in salinity than normal which inhibited the normal growth of this algae. The mud-flats near the outfall were observed throughout the summer, and the extensive mats of *Vaucheria* spp. that normally grow each summer were never present during 2003. In consultation with AWWU and discussions with EPA, it was decided to postpone the bioaccumulation component of the program until the summer of 2004.

In summary, intertidal sediment analyses performed this year indicated that outfall and control sites were similar in terms of chemical concentrations. Most toxic pollutants and pesticides were found to be at or below detection limits, with some potential petroleum product contamination seen in one replicate that was not attributed to the outfall. While some metal concentrations were found to be elevated in respect to NOAA's ER-L benchmarks, these values represent the natural metal levels that are associated with glacial silt in Cook Inlet. There was no evidence of outfall impacts.

6.0 CONCLUSIONS

The following conclusions were based on results from this year of monitoring as compared to the current NPDES permit:

- The influent, effluent, and sludge monitoring has shown that, with the exception of only fecal coliform, the Asplund WPCF met the NPDES permit requirements and complied with State of Alaska water quality standards. MOA's self-monitoring of TRC, pH, BOD_5, and TSS showed compliance with all 2003 permit effluent limitations.

- MOA's self-monitoring of TRC showed that the daily maximum for TRC in the effluent was met for the entire year.

- The maximum geometric mean of 850 FC MPN/100 mL was exceeded in July 2003 for fecal coliform, when a mean of 1,141 FC MPN/100 mL was reported. Fecal coliform exceeded the monthly criteria "that not more than 10 % of the effluent samples shall exceed 2600 FC MPN/100 mL during any month" in June and July 2003, when 14 and 33 % of the samples exceeded this value, respectively. Exceedences resulted from the continuing adjustment of the ORP chlorine feed control system in an effort to optimize chlorine use.

- Yearly average percent removals for BOD_5 (36 %) and TSS (80 %) were considerably better than the 30 % required by the amendment to the Clean Water Act (40 CFR Part 125; Final Rule, 8/9/94).

- Total aqueous hydrocarbon and total aromatic hydrocarbon concentrations in the effluent were below their respective MAECs, as was total ammonia.

- Cyanide and metals concentrations in the effluent never exceeded their MAECs during any of the sampling events.

- Concentrations of toxic pollutants and pesticides, including metals and cyanide, in influent and effluent were generally within the established range or lower than values from a national study of secondary treatment plants. Most toxic pollutant sludge concentrations were within the established range or lower than values from a national study of secondary treatment plants, with some metals falling outside typical concentrations but well below 95^{th} percentile worst case values.

- Whole effluent toxicity testing conducted quarterly during 2003 met the permit limitations for chronic toxicity.

- To test the hypothesis that the water quality at the ZID boundary was not degraded with respect to the water quality at the nearfield and control stations, statistical comparisons were employed. Conventional parameters such as temperature, salinity, pH, and color did show statistically significant differences between stations, but these were not ascribed to the outfall. Rather, these have historically been seen when comparing the Point Woronzof region to the warmer, less saline waters across Knik Arm at the control site. No significant differences were seen for dissolved oxygen or turbidity.

- Fecal coliform concentrations in offshore receiving water samples from stations outside the ZID failed to meet the State-specified criteria of a median of 14 FC MPN/100 mL, a geometric mean of 20 FC MPN/100 mL, and of not more than 10 % of the samples exceeding 40 FC MPN/100 mL. Fecal coliform concentrations in intertidal samples met all of these criteria. Elevated offshore concentrations may be partially attributed to the effluent discharge, since concentrations at the outfall stations were significantly higher than those seen at the control. However, other stations more removed from the diffuser also showed high values, and other factors such as stream inputs may be influencing fecal coliform levels. All fecal coliform samples collected from intertidal areas met water quality criteria.

- Supplemental receiving water quality samples obtained as part of the plume dispersion monitoring indicated that background levels of dissolved metals were all below the State site-specific water quality standards. Significant differences between the outfall and control stations were seen for dissolved arsenic, cadmium, copper, mercury, and zinc, which were elevated at the outfall. These increased concentrations as compared to controls may be attributed to the outfall, but all dissolved metals still met water quality standards. Total recoverable metals were elevated compared to the dissolved, as expected, and this was attributed to high suspended sediment loads. Only total recoverable arsenic was significantly elevated at the outfall stations as compared to the control, also possibly due to increased suspended sediment levels.

- All cyanide concentrations in receiving waters were below detection limits except for the within-ZID Station F1-1, which exhibited a concentration of 2.0 µg/L.

- Supplemental receiving water samples also demonstrated that total aromatic hydrocarbons and total aqueous hydrocarbons exceeded the State's water quality standard at one outfall station, F1-2 at the ZID boundary. While no statistically significant differences were detected between concentrations at the control and outfall stations for total aromatic hydrocarbons, total aqueous hydrocarbons were significantly elevated at the outfall stations as compared to the control stations. These elevated levels could not be directly attributed to the outfall, since concentrations measured in the effluent during the receiving water sampling were found to be low and only one outfall station showed elevated levels of these hydrocarbons.

- Turbidity, color, and TRC met the State water quality criteria at all stations. Total residual chlorine levels were not found to be significantly different between outfall and control stations.

- On September 4, 2003, grease and debris were inadvertently discharged to the outfall during the annual beach tower sluice gate maintenance. This caused a violation of the AWQS which states that discharges “Shall not cause a film, sheen, or discoloration on the surface or floor of the water body or adjoining shorelines. Surface waters shall be virtually free from floating oils." This incident was reported to EPA as required and the debris was immediately cleaned from the beach by AWWU.

- Intertidal sediment analyses showed no evidence of outfall impacts. Data from outfall and control sites were similar in terms of chemical concentrations, with semi-volatile compounds, pesticides, dioxins, or asbestos found to be at or below detection limits.

Cyanide was detected near the detection limit in one replicate from the control station. All metal concentrations were found to be substantially below NOAA's benchmark values indicative of probable environmental impact. Metals concentrations represent the natural metal levels that are associated with glacial silt in Cook Inlet. Subtidal substrates consisted of cobble and coarse gravel and were not subject to chemical analysis.

- Bioaccumulation sampling was not performed due to a lack of algae growth, most likely due to the dryness of the summer during 2003. This monitoring requirement will be performed in 2004.

CONCLUSIONS

Results from this year of the monitoring program confirm previous studies, data in the 301(h) waiver application, and the decision by the EPA to reissue the permit. The Asplund WPCF is operating within regulatory requirements with few exceptions and is showing no significant impacts to the marine environment.

7.0 REFERENCES

Alaska Department of Environmental Conservation, 1999. Alaska Administrative Code. Water Quality Standards, Chapter 70, (18 AAC 70).

American Public Health Association, 1998. Standard Methods for the Examination of Water and Wastewater. 20th Edition. Washington, D.C. Various pagings.

Anchorage Water & Wastewater Utility, 2000. 2000 Monitoring Program Plan. Prepared by the Anchorage Water & Wastewater Utility, Treatment Division, Laboratory Services Section.

CH2M Hill, in association with Ott Water Engineers, Inc., 1984. Application for Modification of Secondary Treatment Requirements, Section 301(h), Clean Water Act. Prepared for Anchorage Water and Wastewater Utility, Anchorage, Alaska.

CH2M Hill, in association with Ott Water Engineers, Inc., 1985. Amendment to Wastewater Facilities Plan for Anchorage, Alaska. Outfall Improvements. Prepared for Anchorage Water and Wastewater Utilities, Anchorage, Alaska.

CH2M Hill, 1987. Industrial waste Pretreatment Program, Annual Report. Point Woronzof Wastewater Treatment Facility. Prepared for the Anchorage Water and Wastewater Utility, Anchorage, Alaska.

CH2M Hill, in association with Loren Leman, P.E., 1988. Industrial Waste Pretreatment Program, Annual Report. Point Woronzof Wastewater Treatment Facility. Prepared for the Anchorage Water and Wastewater Utility, Anchorage, Alaska.

CH2M Hill, 1988. In situ Measurement of Dilution of John M. Asplund Water Pollution Control Facility Effluent in the Cook Inlet at Point Woronzof, Anchorage, Alaska. Prepared for the Municipality of Anchorage.

CH2M Hill, 1997. Air Operating Permit Application. Submitted to the Alaska Department of Environmental Conservation. Prepared for Anchorage Water and Wastewater Utility, Anchorage, Alaska. December 1997.

CH2M Hill, 1998. NPDES Permit Application for NPDES Permit and 301(h) Variance from Secondary Treatment. John M. Asplund Water Pollution Control Facility. Prepared for the Anchorage Water and Wastewater Utility, Municipality of Anchorage, Alaska.

Code of Federal Regulations, 1999. 40 CFR Parts 104; 125; 136; 401; and 503. Title 40. Protection of Environment, U.S. Government Printing Office, Washington, D.C.

Dunn, Olive Jean, 1964. Multiple Comparisons Using Rank Sums. Technometrics, Vol. 6, No. 3:241.

EPA, 1976. Quality Criteria for Water, U.S. Environmental Protection Agency, Washington, D.C., 20460. U.S. Government Printing Office: 1977, 0-222-904.

EPA, 1978. Microbiological Methods for Monitoring the Environment, U. S. Environmental Protection Agency, EPA 600/18-78-017

EPA, 1980. Ambient Water Quality Criteria listed under Section 304(a)(1) of the Clean Water Act, October 1980, EPA 440/5-90-015 through EPA 440/5-90-079, Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. 20470.

EPA, 1982. Fate of Priority Pollutants in Publicly Owned Treatment Works. Final Report, Volume 1, EPA 440/1-82/303, Effluent Guidelines Division, WH-552.

EPA, 1983. Methods for Chemical Analysis of Water and Wastes. U. S. Environmental Protection Agency, EPA 600/4-79/020, revised March 1983.

EPA, 1985a. Final NPDES Permit No. AK-002255-1 and attached Response to Comments on the Tentative Decision Document and Draft Permit for the John M. Asplund Water Pollution Control Facility. Prepared by the EPA 301(h) Review Team, Region 10. September 1985.

EPA, 1985b. Analysis of the Section 301(h), Secondary Treatment Variance Application for the John M. Asplund Water Pollution Control Facility. Prepared by the EPA 301(h) Review Team, Region 10. September, 1985.

EPA, 1985c. Summary of Environmental Profiles and Hazard Indices for Constituents of Municipal Sludge: Methods and Results.

EPA, 1986a. Test Methods for Evaluating Solid Waste. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C., 20460. EPA SW 846.

EPA, 1986b. Quality Criteria for Water, U.S. Environmental Protection Agency, Office of Water Regulations and Standards, Washington, D.C., 20460. EPA 440/5-86-001.

EPA, 1988. Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms. EPA 600/4-87/028.

EPA, 1989. Ambient Aquatic Life Water Quality Criteria for Ammonia (Saltwater). EPA 440/5-88-004.

EPA, 1992. Interim Guidance on Interpretation and Implementation of Aquatic Life Criteria for Metals. Health and Ecological Criteria Division, Office of Science and Technology. U.S. EPA, Washington, D.C., 20460.

EPA, 1993. Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria. October 1, 1993 Memorandum from Martha G. Prothro, Acting Assistant Administrator for Water to EPA Regions I-X.

EPA, 1994. Water Quality Standards Handbook: Second Edition. Office of Water (4305). EPA-823-B-94-005a. U.S. EPA Water Quality Standards Branch, Office of Science and Technology, Washington, D.C., 20460.

EPA, 1994a. U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. U. S. Environmental Protection Agency, Office of Emergency and Remedial Response. EPA 540/R-94/013.

EPA, 1994b. U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review. U. S. Environmental Protection Agency, Office of Emergency and Remedial Response. EPA 540/R-94/012.

EPA, 1995. Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms. First Edition. U. S. Environmental Protection Agency, National Exposure Research Laboratory, Cincinnati, OH. EPA 600/R-95-136.

EPA, 1999a. Method 1664, Revision A. n-Hexane Extractable Material (HEM; Oil and Grease) and Silica Gel Treated n-Hexane Extractable Material (SGT-HEM; Non-polar Material) by Extraction and Gravimetry. February 1999. EPA-821-R-98-002.

EPA, 1999b. Toxicity Reduction Evaluation Guidance for Municipal Wastewater Treatment Plants. EPA 833-B-99-002.

EPA, 2000. Final NPDES Permit No. AK-002255-1 and attached Response to Comments on the Tentative Decision Document and Draft Permit for the John M. Asplund Water Pollution Control Facility. Prepared by the EPA 301(h) Review Team, Region 10. June 2000.

EPA, 2001. September 28, 2001; Letter to Michele Brown, Commissioner, ADEC, from Randall Smith, Director, Office of Water, EPA.

EPA and Jones & Stokes Associates, Inc., 1982. Draft Environmental Impact Statement. Municipality of Anchorage Sewage Facilities Plan, Anchorage, Alaska. November 1982.

Long, E.R., D.D. Macdonald, S.L. Smith, and F.D. Calder. 1995. Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. *Environ. Management.* 19: 81-97.

Kinnetic Laboratories, Inc., 1979. Supplemental Studies of Anchorage Wastewater Discharge off Point Woronzof in Upper Cook Inlet. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska, R-79-13.

Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, in association with R. W. Hoffman, Ph.D., 1987a. Point Woronzof Monitoring Program, Annual Report, October 1985-1986. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, in association with R. W. Hoffman, Ph.D., 1987b. Point Woronzof Monitoring Program, Annual Report, November 1986-October 1987. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, 1988. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, November 1987-October 1988. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, 1989. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, November 1988-October 1989. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, 1991. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, November 1989-October 1990. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, 1992. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, November 1990-October 1991. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, 1993. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, November 1991-October 1992. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, 1994. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, November 1992-October 1993. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, 1995. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, November 1993-October 1994. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, 1996. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, November 1994-October 1995. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, 1997. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, November 1995-October 1996. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, 1998. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, November 1996-

October 1997. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, 1999. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, November 1997-October 1998. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kinnetic Laboratories, Inc., 2000a. Point Woronzof Wastewater Treatment Facility, Monitoring Program Workplan, October 2000. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kinnetic Laboratories, Inc., 2000b. Point Woronzof Wastewater Treatment Facility, Initial Investigation - Toxicity Reduction Evaluation (TRE) Workplan, October 2000. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, 2000c. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, November 1998-October 1999. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kinnetic Laboratories, Inc., with Technical Review by CH2M Hill, 2001. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, January – December 2000. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kinnetic Laboratories, Inc. 2002. Point Woronzof Wastewater Treatment Facility, Monitoring Program Annual Report, January – December 2001. Prepared for the Municipality of Anchorage Water and Wastewater Utility, Anchorage, Alaska.

Kozloff, E.N. 1993. Seashore Life of the Northern Pacific Coast, An Illustrated Guide to Northern California, Oregon, Washington, and British Columbia. University of Washington Press, 370 pp.

NOAA/NOS.1995. Tide Tables 1995, High and low water predictions, West Coast of North and South America. U.S. Department of Commerce.

Micronautics, Inc. 2003. Tide1: Rise and Fall/Tide2: Ebb and Flow, Micronautics, Inc. © 1986-2003. Rockport, ME. Tide Tables 2003, High and Low Water Predictions, West Coast of North and South America.

Ott Water Engineers, Inc., Quadra Engineering, Inc., and Black and Veatch Consulting Engineers, 1982. Wastewater Facilities Plan for Anchorage, Alaska. Prepared for Anchorage Water and Wastewater Utilities, Anchorage, Alaska.

Sombardier, L. and P.P. Niiler, 1994. Global Surface Circulation Measured by Lagrangian Drifters. Sea Technology, October 1994. pp. 21-24.

UNESCO and National Institute of Great Britain, 1973. International Oceanographic Tables, Volume 2 (82 pp.)

Zar, J.H. 1984. Biostatistical Analysis. Second Addition. Prentice-Hall, Inc., Englewood Cliffs, NJ. 718 pp.